

ARTIFICIAL INTELLIGENCE AND THE DEVELOPMENT OF CRITICAL THINKING IN UNIVERSITY EDUCATION: A SYSTEMATIC REVIEW

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ABSTRACT

This research aimed to review the current scientific literature on the use of artificial intelligence to strengthen critical thinking in higher education, considering articles published between 2020 and 2025. A systematic review was conducted using the PRISMA methodology, analyzing twenty scientific articles obtained from specialized databases. The results showed that artificial intelligence is a tool with potential to strengthen critical thinking in university education. Among the main practices identified are personalized learning, the use of intelligent tutoring systems, content generation, automated feedback, optimized information retrieval, and the development of autonomous learning. These applications promote higher-order cognitive processes such as analysis, reflection, argumentation, and problem-solving. However, limitations were also identified related to technological dependence, the inappropriate use of AI for unethical academic practices, the decline of critical analysis, the risk of plagiarism, data privacy, and algorithmic biases. Furthermore, the main challenges for its implementation were related to artificial intelligence literacy, teacher and student training, the creation of ethical and regulatory frameworks, and the design of pedagogical strategies that allow AI to be integrated as a complementary tool without replacing human cognitive abilities.

KEYWORDS: artificial intelligence, critical thinking, education, university, digital tools

1. INTRODUCTION

In recent years, artificial intelligence (AI) has gained an increasingly prominent role in the educational context due to its capacity to transform teaching and learning processes. Countries such as the United States, the United Kingdom, China, and Australia have promoted various research initiatives and experiences aimed at integrating these technologies into higher education, showing progress in the personalization of learning, the automation of academic processes, and the strengthening of digital competencies. Nevertheless, limitations persist in the consolidation of scientific collaboration networks capable of generating solid evidence on the effects of AI on the development of complex cognitive competencies, including critical thinking, which is considered an essential skill for training professionals capable of analyzing, arguing, and making well-founded decisions (Cabero et al., 2022).

In Latin America, the incorporation of artificial intelligence into higher education is advancing progressively; however, inequalities persist in access to technological infrastructure, limitations remain in faculty training, and there is a limited body of scientific production that specifically analyzes the relationship between AI and the development of critical thinking (Acevedo et al., 2025). This situation hinders the identification of effective pedagogical strategies and the formulation of guidelines to steer its responsible implementation in university settings.

Artificial intelligence is defined as a field of computer science focused on developing systems capable of performing tasks that normally require human intelligence, such as reasoning, learning, problem-solving, and decision-making (Herrera et al., 2024). In the educational sphere, these capabilities make it possible to personalize learning, facilitate access to information, provide immediate feedback, and support the development of learning experiences better adapted to students' needs (Granda et al., 2024). However, harnessing this potential depends on adequate pedagogical integration that fosters reflection, argumentation, and autonomy, while preventing technology from replacing students' own cognitive processes.

Critical thinking, for its part, constitutes a fundamental competency in university education, as it enables the objective analysis, interpretation, and evaluation of information to make well-founded judgments, solve problems, and make decisions across different academic and professional contexts (Tasayco et al., 2024). In a technological environment,

strengthening this competency is essential so that students can use artificial intelligence in a reflective, ethical, and responsible manner.

Several studies have demonstrated the potential of artificial intelligence to foster the development of critical thinking. Puche (2025) points out that AI can optimize teaching and learning processes, strengthening analytical skills when used as a supporting resource rather than a substitute for human reasoning. Likewise, Pauca et al. (2025) found that immediate access to academic information and the efficient organization of content allow students to devote more time to analysis, interpretation, and critical reflection. Similarly, Atencio et al. (2024) highlight that tools such as ChatGPT can strengthen critical and analytical thinking by promoting reflection and the interpretation of information, provided their use is guided by ethical principles and appropriate pedagogical strategies.

Nonetheless, the literature also warns of significant limitations and challenges associated with incorporating artificial intelligence into higher education. Castillejos (2022) argues that the inappropriate use of these tools can encourage unethical academic practices, generate technological dependence, and diminish the cognitive effort required for the development of critical thinking. Along the same lines, Bustamante and Camacho (2024) emphasize that the adoption of AI requires strengthening the digital competencies of both faculty and students, as well as promoting ethical criteria to guide its responsible use and contribute to comprehensive learning development.

Despite the growing number of studies on artificial intelligence in higher education, the scientific evidence remains scattered and shows heterogeneous results regarding its influence on the development of critical thinking. While some studies highlight benefits related to the personalization of learning, autonomy, and the strengthening of cognitive skills, others warn of risks associated with technological dependence, academic plagiarism, ethical dilemmas, and a decline in analytical capacity.

Moreover, systematic reviews that integrate these findings and jointly identify the best practices implemented, the main limitations, and the challenges for the adoption of artificial intelligence in higher education remain scarce (Navarro, 2024).

In this context, the general objective of this systematic review is to analyze the scientific literature indexed in specialized databases, published between 2020 and 2025, on the application of artificial intelligence for the development of critical thinking in university education. It also seeks to identify the best practices implemented, the main limitations, and the challenges faced by the academic sector in adopting these emerging technologies.

2. METHODOLOGY

The research was carried out through a systematic review of the scientific literature, as this methodological option is the most suitable for analyzing, in a structured and rigorous manner, recent contributions on the use of artificial intelligence for the development of critical thinking in the university setting. The systematic review made it possible to correctly select, review, and interpret critical, relevant, and up-to-date studies in order to condense the significant findings that helped shape the body of knowledge on this topic. Throughout the methodological process, the PRISMA model proposed by Alcoba (2024) was followed to ensure the transparency and rigor required at the different stages of the document analysis.

Taking the above into account, and in order to guarantee the quality of the information gathered, scientific information sources consisting of publications in peer-reviewed or indexed journals and documents from institutional repositories were considered. Following the recommendations put forward by Barrios et al. (2021), this study established a phase encompassing the definition of the objective, the collection of information sources, the application of inclusion and exclusion criteria, and the analytical reading of the selected texts, through to the identification of their main contributions; a series of results related to the study variable were then presented.

Studies in both English and Spanish were selected, given that the scientific literature related to the teaching of English as a foreign language has seen substantial development in Anglo-Saxon countries, while Spanish-language studies offered evidence contextualized to Latin American realities such as Peru's. The search range was set from January 2020 to 2025, with the aim of gathering recent studies that revealed the transformations brought about by the inclusion of artificial intelligence and its connection to the development of critical thinking. This period was considered appropriate for identifying innovations in AI-driven methodologies.

To ensure the consistency and robustness of the evidence analyzed, databases such as SciELO, Scopus, and/or WoS were selected based on their level of indexing, international scope, and credibility in disseminating peer-reviewed scientific literature. This access to research published in specialized journals contributes to the validity and rigor of the analysis conducted.

The search process was carried out using keywords and Boolean operators carefully defined to cover the central theme of the study. The following combined search string was used: (“Artificial intelligence” OR “critical thinking”) AND (“AI” OR “university education”) AND (“technology” OR “digital tools” OR “critical thinking”) AND (“university education” OR “AI”).

This string was also applied in English in order to broaden coverage across international databases and facilitate the retrieval of relevant studies addressing the intersection between AI and critical thinking in university education.

In general terms, the predominant thematic aspects of the content of the selected studies were broadly related to the study variables. In order to preserve the relevance of the review conducted, exclusion criteria were applied during the content-collection procedure, such as the removal of duplicate documents, documents falling outside the established date range (2020–2025), texts not found in the selected databases, and, finally, articles with restricted access, articles not specifically concerned with oral production in English, or those with a tangential subject matter that did not sufficiently develop the proposal, results, or approaches.

Finally, after applying the inclusion and exclusion criteria, the initial number of 128 potentially relevant publications was progressively reduced to a total of 20 selected studies, which were analyzed in terms of their contribution to the article's objective. The screening and selection process was carried out systematically and clearly and is illustrated through the PRISMA flow diagram, shown in Figure 1, a visual representation tool for the traceability of the process conducted in this review.

Figure 1. PRISMA flow diagram for the systematic review

Stage	Description
Identification	Keywords: artificial intelligence, critical thinking, university education, digital tools
Selection	Records identified (n = 105) → Duplicate records removed (n = 15) → Records after removal of duplicates (n = 90)
Eligibility	Records selected (n = 29) → Records excluded for not meeting inclusion criteria (n = 61)
Inclusion	Eligible articles (n = 25) → Records excluded, incorrect publication type (n = 5); Records included: SciELO (n = 10), Scopus (n = 5), WoS (n = 5)

3. RESULTS

Table 1. Best practices implemented through artificial intelligence for the development of critical thinking in university education

Author (Year)	AI tool / application used	Best practice implemented	Implications for higher education
Paucca et al. (2025)	Artificial intelligence	Appropriate use of AI to support the search for and organization of academic information.	Fosters the development of critical thinking by optimizing information search time and promoting a deeper analysis of academic content.
Atencio et al. (2023)	ChatGPT	Use of ChatGPT as a supporting resource to strengthen critical and analytical thinking.	Promotes educational innovation and strengthens students' analytical and critical reflection skills, provided its use is ethical and guided by the instructor.
Romaní & Macedo (2024)	Artificial intelligence	Integration of AI as a supporting resource in the learning process to strengthen critical thinking.	Incorporating AI into training processes can strengthen critical thinking and foster more reflective learning when properly integrated into higher education.
Puche (2024)	Artificial intelligence	Integration of artificial intelligence as a learning support to strengthen critical thinking.	Incorporating artificial intelligence into teaching processes can enhance critical thinking and improve university students' analytical and information-processing abilities.
Bolaño & Duarte (2024)	Artificial intelligence	Personalization of learning through AI to promote reflective	Contributes to improving teaching and learning processes, promoting

Author (Year)	AI tool / application used	Best practice implemented	Implications for higher education
		processes and autonomous analysis.	more adaptive, student-centered educational experiences.
Duque et al. (2025)	Artificial intelligence	Incorporation of adaptive platforms and innovative technologies into teaching processes.	The integration of AI-based technologies contributes to innovating teaching practice and strengthening the quality of instruction in higher education.
Menacho et al. (2024)	Artificial intelligence	Use of AI to strengthen autonomous learning and optimize the search for academic information.	Its integration promotes more autonomous and efficient learning processes, strengthening the academic competencies of university students.
Rojas et al. (2024)	Artificial intelligence	Use of AI to support personalized learning and problem-solving.	Fosters more personalized learning processes, optimizes access to information, and contributes to the development of critical competencies.
Romaní et al. (2025)	Generative Artificial Intelligence (GenAI)	Design of adaptive and personalized learning experiences.	Fosters educational innovation through learning experiences better adapted to students' needs and promotes greater interaction with academic content.
Barrios & Carazas (2025)	AI literacy	Development of AI competencies for the critical, technical, and ethical use of intelligent tools.	Strengthens critical thinking, improves the learning experience, and promotes the responsible use of AI in university academic processes.
Gallent et al. (2024)	Intelligent tutoring systems and AI-based personalized education	Personalization of learning and monitoring of academic performance.	Fosters personalized learning processes, improves educational interaction, and can contribute to the development of higher-order cognitive skills when used as pedagogical support.
Cárdenas et al. (2025)	Artificial intelligence and educational technology tools	Integration of technological tools and innovative teaching strategies to strengthen critical thinking.	Combining AI with active methodologies can strengthen autonomy, critical reasoning, and the participation of university students.
Arteaga & Rivadeneira (2025)	Artificial intelligence tools	Use of AI tools to support the strengthening of critical analysis and problem-solving skills.	The pedagogical integration of AI as an educational resource can foster higher-order cognitive processes and contribute to strengthening critical thinking.
Rodríguez et al. (2025)	Intelligent tutoring systems, AI tools, and data-analysis techniques	Personalization of learning, intelligent tutoring, and automated feedback.	Fosters more adaptive learning experiences, improves academic support, and can strengthen cognitive skills through more

Author (Year)	AI tool / application used	Best practice implemented	Implications for higher education
			personalized interaction with content.
Uzcátegui & Ríos (2025)	Artificial intelligence applied to education	Personalization of learning, automation of processes, and support for pedagogical decision-making.	Fosters educational innovation and enables the development of more personalized, efficient teaching processes oriented toward students' needs.
Franco (2025)	Artificial intelligence tools for data analysis and resource generation	Use of AI as a supporting tool to optimize creative and cognitive processes.	The integration of AI as pedagogical support can foster processes of innovation, creativity, and the development of higher-order cognitive skills in university students.

Note. Own elaboration based on the review of articles.

Table 1 presents the main practices identified in the scientific literature on the application of artificial intelligence in higher education. The studies analyzed show that AI has been used as a supporting tool for the personalization of learning, content generation, intelligent tutoring, academic feedback, optimization of information searches, and the strengthening of higher-order cognitive skills. It is also noted that its appropriate integration fosters processes of analysis, reflection, problem-solving, and decision-making, contributing to the development of critical thinking among university students.

Table 2. Main limitations of artificial intelligence in the development of critical thinking in university education

Author (Year)	Limitation identified	Implications for higher education
Castillejos (2022)	Inappropriate use of AI for unethical academic practices.	Limits the development of critical and creative thinking; institutions must therefore promote the responsible and supervised use of AI.
Bolaño & Duarte (2024)	Poor data quality can affect the reliability of AI-generated information and limit critical-analysis processes.	It is necessary to guarantee high-quality information to obtain reliable results and foster effective educational processes.
Rojas et al. (2024)	Technological dependence and decline in critical analysis.	It is necessary to promote pedagogical strategies that prevent technological dependence and strengthen the development of higher-order cognitive skills.
Oviedo (2023)	Ethical dilemmas and risk of technological dependence.	Institutions must promote the critical use of AI, preventing it from replacing processes of reflection, analysis, and knowledge construction.
Gallent et al. (2024)	Risks related to privacy, algorithmic bias, and educational inequality.	Institutions must guarantee safe, transparent, and equitable conditions of use to avoid negative effects on educational processes.
Bayas (2024)	Excessive dependence on artificial intelligence.	Universities must promote a balanced use of AI, preventing it from replacing the cognitive processes required for analysis, reflection, and decision-making.

Author (Year)	Limitation identified	Implications for higher education
Rodríguez et al. (2025)	Risk of plagiarism and generation of non-authentic content.	Institutions must strengthen academic integrity and promote the use of AI oriented toward analysis, reflection, and students' own construction of knowledge.
Verdegay et al. (2021)	Risk of replacing human reasoning and decision-making.	In higher education, it is necessary to promote the use of AI as a complementary tool, preventing it from replacing students' processes of analysis, reflection, and decision-making.

Note. Own elaboration based on the review of articles.

Table 2 synthesizes the main limitations reported in the studies regarding the use of artificial intelligence in university educational processes. Among the difficulties identified are technological dependence, the decline in autonomous reasoning, the risk of plagiarism, the generation of non-authentic content, and problems related to data quality, privacy, and algorithmic bias. These results show that the inappropriate use of AI can affect the development of cognitive skills such as critical analysis, reflection, and independent decision-making.

Table 3. Main challenges for the adoption of artificial intelligence oriented toward the development of critical thinking in university education

Author (Year)	Challenge identified	Implications for higher education
Atencio et al. (2023)	Regulating and guiding the ethical use of ChatGPT in the university setting.	Institutions must establish guidance and pedagogical strategies that guarantee the responsible use of AI in order to prevent inappropriate practices and enhance learning.
Castillejos (2022)	Promoting the ethical use of artificial intelligence.	Universities must implement policies, guidelines, and training strategies that promote the ethical use of AI and strengthen students' critical thinking.
Bolaño & Duarte (2024)	Strengthening the training of faculty and students in AI-related competencies.	Higher education institutions must implement continuous training programs that enable the responsible and effective adoption of artificial intelligence.
Menacho et al. (2024)	Promoting the ethical and responsible use of artificial intelligence.	Institutions must establish guidelines and training strategies that promote the responsible use of AI and strengthen the digital competencies of the university community.
Rojas et al. (2024)	Adequately integrating AI into teaching and learning processes.	Institutions must design pedagogical strategies that integrate AI as a supporting tool, promoting autonomous learning without replacing students' critical reasoning.
Duque et al. (2025)	Increasing the incorporation of AI into teaching processes.	Institutions must promote innovation strategies, faculty training, and the incorporation of adaptive platforms to strengthen the adoption of AI.
Romaní et al. (2025)	AI literacy and ethical use of technology.	Institutions must strengthen training in digital competencies and establish ethical

Author (Year)	Challenge identified	Implications for higher education
		guidance for the proper integration of AI into teaching processes.
Oviedo (2023)	Defining the role of AI in relation to human thought and academic training.	Universities must establish strategies that integrate AI as a complementary tool, strengthening critical thinking, academic ethics, and student autonomy.
Barrios & Carazas (2025)	Strengthening AI literacy among students and faculty.	Universities must incorporate AI training programs that enable the responsible and effective integration of these technologies into teaching and learning.
Gallent et al. (2024)	Establishing ethical and regulatory frameworks for the implementation of AI.	Universities must develop ethical guidelines, internal regulations, and governance strategies that allow the benefits of AI to be harnessed without compromising safety or educational equity.
Arteaga & Rivadeneira (2025)	Designing pedagogical strategies for a critical and responsible integration of AI.	Institutions must develop educational strategies that guide the use of AI as a complementary tool to consolidate higher-order intellectual competencies.
Bayas (2024)	Balancing the use of AI with the strengthening of cognitive competencies.	Institutions must design pedagogical strategies that make it possible to harness the benefits of AI while maintaining the development of higher-order cognitive skills.
Rodríguez et al. (2025)	Implementing an ethical, responsible, and trustworthy artificial intelligence.	Universities must establish policies, usage criteria, and ethics training to guarantee the safe and responsible adoption of AI.
Uzcátegui & Ríos (2025)	Guaranteeing an ethical, equitable, and responsible integration of AI.	Institutions must establish policies, ethical criteria, and implementation strategies that guide the responsible use of AI in educational processes.
Verdegay et al. (2021)	Establishing ethical criteria for the operation and use of AI systems.	Educational institutions must develop ethical frameworks and governance criteria that regulate the use of AI, preserving critical thinking and human responsibility.
Franco (2025)	Maintaining the role of human capabilities in the face of automation.	Universities must promote pedagogical strategies in which AI supports learning while keeping the student as the central figure in the cognitive and creative process.

Note. Own elaboration based on the review of articles.

Table 3 presents the main challenges identified in the scientific literature related to the incorporation of artificial intelligence in the university context. The studies highlight the need to strengthen AI literacy among faculty and students, establish ethical and regulatory frameworks, guarantee the responsible use of these technologies, protect information privacy, and develop pedagogical strategies that integrate AI without replacing human capabilities. In this sense, the effective adoption of artificial intelligence requires planned implementation that makes it possible to harness its benefits while reducing potential risks in training processes.

4. DISCUSSION

The findings of this systematic review show that artificial intelligence has become established as a tool with significant potential to strengthen critical thinking in university education, provided its implementation is supported by appropriate pedagogical strategies. Regarding the best practices implemented through artificial intelligence for the development of critical thinking in university education, the scientific evidence reviewed shows a consensus in recognizing AI as a tool that strengthens teaching and learning processes when integrated through suitable pedagogical strategies. The studies analyzed highlight that the personalization of learning, autonomous learning, immediate feedback, efficient access to information, and the use of adaptive platforms constitute the main practices implemented in the university context. In this regard, Pauca et al. (2025) show that AI optimizes the search for and organization of academic information, allowing students to devote more time to the analysis and interpretation of content. Likewise, Menacho et al. (2024) note that these tools strengthen autonomous learning, while Atencio et al. (2023) highlight that ChatGPT fosters the development of critical and analytical thinking when its use is guided by pedagogical and ethical criteria. These results are consistent with those reported by Romaní and Macedo (2024), Puche (2024), Arteaga and Rivadeneira (2025), and Cárdenas et al. (2025), who maintain that AI contributes to strengthening higher-order cognitive skills such as reasoning, argumentation, problem-solving, and decision-making.

With regard to the main limitations of artificial intelligence in the development of critical thinking, the studies reviewed show that the greatest risk lies in the technological dependence arising from the inappropriate use of these tools. Several authors agree that excessive use of AI can diminish the capacity for analysis, reflection, and autonomous decision-making when it replaces the student's cognitive effort. In this regard, Rojas et al. (2024), Bayas (2024), and Oviedo (2023) warn that technological dependence can negatively affect the development of critical thinking by reducing independent reasoning during problem-solving. Similarly, Castillejos (2022) points out that the unethical use of AI encourages inappropriate academic practices, while Rodríguez et al. (2025) highlight the risk of plagiarism and the generation of content lacking authenticity. These limitations are compounded by concerns related to the quality of the information used by intelligent systems, algorithmic bias, data privacy, and inequalities in access to these technologies, aspects identified by Bolaño and Duarte (2024), Gallent et al. (2024), and Verdegay et al. (2021).

As for the main challenges for the adoption of artificial intelligence in higher education, the literature reviewed shows broad consensus on the need to strengthen ethical training and digital competencies within the university community. The studies by Atencio et al. (2023), Castillejos (2022), Menacho et al. (2024), Rodríguez et al. (2025), and Uzcátegui and Ríos (2025) agree that one of the greatest challenges consists in guaranteeing an ethical, responsible, and critical use of artificial intelligence through institutional policies and pedagogical guidelines that regulate its use. Likewise, Bolaño and Duarte (2024), Romaní et al. (2025), and Barrios and Carazas (2025) emphasize the importance of promoting AI literacy processes and ongoing training programs aimed at both faculty and students, with the goal of developing digital competencies that allow these technologies to be used critically and responsibly. Furthermore, Rojas et al. (2024), Duque et al. (2025), Arteaga and Rivadeneira (2025), and Franco (2025) emphasize that AI should be incorporated as a complementary tool within the educational process, preserving the student's central role in the construction of knowledge and preventing automation from replacing analysis, reflection, and decision-making. Finally, Gallent et al. (2024) and Verdegay et al. (2021) stress the need to establish ethical and regulatory frameworks that guarantee a safe, transparent, and equitable implementation of these technologies in higher education.

5. CONCLUSIONS

This systematic review made it possible to conclude that artificial intelligence fosters the development of critical thinking in university education by strengthening autonomous learning, the personalization of instruction, access to information, and the capacity for analysis and reflection. However, these benefits depend on adequate pedagogical integration and the responsible use of these tools.

Among the main limitations identified are technological dependence, the risk of plagiarism, the decline in critical analysis, algorithmic bias, and concerns related to the privacy and quality of information. These aspects can affect the development of critical thinking when AI replaces the student's own reasoning.

The main challenges for higher education institutions consist in strengthening artificial intelligence literacy, promoting the training of faculty and students, and establishing ethical guidelines to steer its responsible implementation within teaching and learning processes.

In summary, artificial intelligence constitutes a valuable resource for university education when used as a tool that supports learning rather than as a substitute for human thought, contributing to the development of higher-order cognitive competencies and to a more critical and reflective professional education.

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