

# Educational transformations in the age of artificial intelligence

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## Introduction

In recent decades, humanity has undergone a radical transformation driven by the advancement of artificial intelligence (AI). This phenomenon has generated deep interest in different social, economic and academic sectors due to its ability to modify traditional knowledge structures and processes. In particular, the educational field is at an inflection point, in which AI is no longer a mere technological tool but an agent of change that redefines teaching, learning, and assessment practices (Crompton & Burke, 2023).

Within higher education institutions, the implementation of AI opens up a range of possibilities aimed at personalizing learning, automating administrative tasks, and strengthening academic research. However, it also poses ethical, pedagogical, and social challenges that need to be addressed critically and responsibly (Jacques, Moss, & Garger, 2024). Understanding these implications is essential to ensure that AI contributes to the integral development of students, promoting digital skills, critical thinking and humanistic training in an increasingly digitalised environment (Nebieridze & Jojua, 2025).

## Theoretical framework

The emergence of artificial intelligence in the contemporary context has triggered debates, research and reflections on its role in the different fields of knowledge. Beyond its technical nature, AI is an opportunity to reimagine education from an innovative and adaptive approach. According to Long, Wang, and Lu (2025), the use of intelligent systems in the classroom can enhance student engagement and motivation, by offering more dynamic and personalized learning experiences.

In the university environment, AI has become a driver of educational innovation. Their presence allows them to optimize teaching processes through adaptive platforms, virtual assistants and data analysis tools that favor immediate feedback. However, their adoption also implies the need to train future professionals in the ethical and critical use of these technologies (Education Sciences, 2024). Higher education institutions must take responsibility for integrating digital literacy and understanding of AI principles within their curricula, avoiding falling into a new type of technological illiteracy that could limit academic and professional development (Crompton & Burke, 2023).

Likewise, the emergence of Generative Artificial Intelligence (AGI) represents a new stage in the relationship between technology and education. This aspect, based on models capable of creating text, images or code, offers enormous potential for pedagogical innovation, although it also requires ethical reflection on its responsible use (Springer, 2024). According to Jacques et al. (2024), AGI can be a valuable resource for fostering creativity, autonomy, and complex problem-solving, as long as it is used as a support tool and not as a substitute for human thinking.

Therefore, the integration of AI in higher education should not be limited to an instrumental or utilitarian vision, but should be oriented towards a deeper transformation of the educational paradigm. Universities must promote a culture of responsible innovation, based on continuous teacher training, curricular updating and the promotion of ethical values that guide the use of technology (Nebieridze & Jojua, 2025).

Technological advances have proven to be an essential tool to facilitate human activities in multiple areas, and education has been no exception. Artificial intelligence (AI) has positioned itself as one of the most influential developments, contributing significantly to research and strengthening the substantive functions of education. In this context, it is important to reflect on the concepts of *education* and *artificial intelligence* from different theoretical perspectives. According to León (2007), education is a complex human and cultural process that must be understood in its entirety, considering the nature of the human being and culture. The author emphasizes that each aspect of the educational process makes sense based on its interrelation with the other elements, thus strengthening the social and cultural fabric.

From a more dialogical position, Freire (2007) argues that education is an essentially human practice in which "no one educates anyone, but we all educate each other through communicative praxis", with dialogue being the mediator of this process. For the author, education is a liberating and permanent action, aimed at the critical and collective development of the human being (Freire, 2005).

For their part, Díaz and Alemán (2011) propose an etymological reading of the concept of education, highlighting two Latin roots: *educare*, understood as the action of providing knowledge from the outside, and *educacere*, as the process of extracting or developing internal potentialities. In his analysis, both senses complement each other, since education involves both guiding and leading and promoting the development of the inherent capacities of each individual.

In this sense, education can be understood as a dynamic process that arises from the exchange of experiences between teachers and students, articulating learning that is linked to the social and cultural reality of the individual. Over time, the different pedagogical currents – from behaviorism to constructivism and competency-based teaching – have contributed to enriching educational practice, evidencing its evolution and constant adaptation.

In the technological field, artificial intelligence has taken on a leading role in the transformation of contemporary education. Naranjo (2011) points out that recent history is marked by the emergence of technologies that facilitate human life, such as computers, satellites, internet protocols, virtual reality or compact discs, among others, all of which paved the way for the emergence of AI.

Haugeland (1988) defines artificial intelligence as an innovation that allows computers to perform functions similar to those of human thought, to the point that they could come to possess an "artificial mind". More recently, Gallent-Torres et al. (2023) synthesize this concept by describing AI as the ability of machines to mimic human intelligence.

Despite its benefits, the expansion of AI has raised fears related to the replacement of human labor. Basco et al. (2018) warn that the automation of medium-complexity tasks can cause work displacements; However, they also stress that more automated economies tend to register an increase in employment due to the higher productivity generated by new technologies.

Consequently, AI should not be seen only as a threat, but as a support tool in the construction of new productive and educational processes. In this sense, its integration into teaching-learning can favour more inclusive, flexible and personalised methodologies, promoting ethical, critical and socially responsible learning. Martínez et al. (2020) agree that automation and robotics are transforming productive sectors, and that these changes require educational adaptation to avoid job insecurity.

In recent years, research on AI in education has grown significantly. Sanabria-Navarro et al. (2023) highlight that the future of higher education is oriented towards teaching modalities supported by artificial intelligence software, particularly in adaptive learning and data analysis. Similarly, Zhou (2023) stresses that curricular reorganization and pedagogical transformation are key to strengthening educational quality through AI.

An example of how AI has impacted globally was evidenced during the COVID-19 pandemic. This event led to social confinement and the intensive use of digital technologies in educational processes. Piña-Ferrer (2020) reflects that crises generate uncertainty, but they also drive the search for new ways to face social, cultural, and educational challenges.

Currently, the implementation of artificial intelligence in higher education has advanced most strongly in developed countries. Abdala et al. (2019) highlight the case of China, which has incorporated AI learning at all educational levels, with special attention to universities, integrating technology into academic training and industry. In Europe, universities such as Cambridge and Oxford are also leading this transformation, offering specialized programs in data science, artificial intelligence, and machine learning (Russell et al., 2015).

In short, artificial intelligence represents a turning point in educational evolution and knowledge transfer. Its responsible application can not only improve teaching and learning processes in educational institutions and business environments, but also prepare new generations to face the challenges of the future, combining technological innovation with ethical and social reflection.

The growth of artificial intelligence (AI) has motivated numerous universities to revamp their educational and research models. A clear example is the University of Helsinki (Finland), which launched the free online course "Elements of AI", aimed at teaching the fundamentals of AI to students and the general public, with the aim of promoting the understanding of this technology as a useful tool in various social and professional contexts (University of Helsinki, 2023).

Similarly, several European institutions have strengthened their academic programmes around AI and technological sciences. These include the Technical University of Munich (Germany), the University of Delft (Netherlands), the University of Barcelona, the Complutense University of Madrid (Spain) and the University of Copenhagen (Denmark). These universities have incorporated AI into their curricula, mainly in areas such as digital engineering, data science, applied computer science, and interdisciplinary research (Xia, Li & Li, 2024).

In North America, the adoption of AI in universities has also become very relevant. For example, the Massachusetts Institute of Technology (MIT) has integrated AI into Electrical Engineering and Computer Science programs, pioneering the teaching of this discipline (Tadimalla & Maher, 2024). In addition, ELIZA, one of the first chatbots in history, was developed at this academic center, considered an initial milestone of Generative Artificial Intelligence (Díaz Vera et al., 2024).

Díaz Vera et al. (2024) explain that Generative Artificial Intelligence (AGI) has evolved significantly from ELIZA to modern systems capable of generating complex and creative content, with impacts in the educational, economic, and labor fields. Their application in education has generated debates on the effectiveness of these tools for the development of teaching materials and the planning of pedagogical strategies.

Other U.S. universities have also shown a strong commitment to AI research and teaching. Stanford University offers courses focused on machine learning, robotics, and digital ethics, promoting a comprehensive view of the responsible use of technology (Designing an Interdisciplinary AI Curriculum, 2025). For its part, Carnegie Mellon University has established itself as a world leader in AI and robotics, with undergraduate and graduate programs dedicated to these areas. The University of California, Berkeley has strengthened its research in AI applied to computer science, focusing on technological innovation for the resolution of social and scientific problems (Xia, Li & Li, 2024).

These initiatives show how universities are adapting their academic programs to technological change, training professionals capable of functioning in environments characterized by automation, digitalization, and algorithmic thinking (University of Helsinki, 2023; Tadimalla & Maher, 2024; Díaz Vera et al., 2024).

## Methodology

This research has a quantitative, descriptive and explanatory approach, aimed at examining how the implementation of artificial intelligence (AI) impacts university teaching in particular and teaching-learning processes in general. This approach makes it possible to objectively measure and analyse teachers' perceptions, experiences and practices in relation to the use of AI, as well as to identify the benefits and challenges associated with its incorporation into higher education (Crompton & Burke, 2023; Jacques, Moss & Garger, 2024).

### Population and sample

The study population is made up of university professors from various academic areas of the University of Madrid. For this study, a sample of 100 teachers was selected, chosen through a non-probabilistic sampling for convenience.

### Data collection tool

For the collection of information, a structured questionnaire was designed composed of closed questions and Likert scale, divided into three main blocks:

Knowledge of and familiarity with AI: level of understanding of fundamental concepts and previous experience in using AI tools.

Application in educational practice: frequency and type of integration of AI in teaching, tools used and perception of its effectiveness.

Perception of ethical benefits and challenges: evaluation of pedagogical advantages, associated risks, implementation challenges, and ethical aspects of the use of AI in higher education (Nebieridze & Jojua, 2025; Long, Wang & Lu, 2025).

The questionnaire was validated through the judgment of experts in educational and pedagogical technology, and a pilot test was carried out with 10 teachers to ensure the clarity of the questions and the internal coherence of the instrument. For the procedure, the following was performed:

✓ The collaboration of the teachers was requested through institutional mail and direct communication, explaining the objectives of the study and ensuring the confidentiality of their answers.

✓ The questionnaire was administered in person at the university, within the academic facilities and for a certain period of time to facilitate participation.

✓ The data collected were coded and analyzed using descriptive statistical techniques (frequencies, percentages and averages) using specialized software, such as SPSS and Excel.

For the data analysis, it was possible to identify:

- The level of knowledge of teachers about AI and its relationship with the application in the classroom.
- The frequency and type of use of AI tools in university teaching.
- The perception of the benefits, limitations and ethical aspects related to AI.

The objective of this procedure is to provide reliable and representative information on the integration of AI in university education, facilitating the identification of opportunities and areas for improvement in teaching practice (Sanabria-Navarro et al., 2023; Zhou, 2023).

## Results

The main objective of this research was to analyze the impact and opportunities offered by artificial intelligence in higher education, identifying how its integration into academic programs contributes to educational innovation and the development of digital skills and critical thinking in students. The sample consisted of 100 university professors, and the data were collected through a structured questionnaire applied face-to-face at

the university, with blocks focused on knowledge about AI, use of AI in teaching, and perception of ethical and pedagogical benefits and challenges.

#### 1. Knowledge about AI

The teachers showed different levels of knowledge regarding artificial intelligence:

- Intermediate knowledge: 65% of teachers indicated that they have intermediate knowledge, which demonstrates familiarity with basic concepts and technological tools, although not all of them have systematically integrated AI into their classes.
- High knowledge: 20% reported a high level of knowledge, with hands-on experience using intelligent systems and machine learning.
- Low knowledge: 15% acknowledged having limited knowledge, reflecting the need for training and digital literacy programs to ensure effective use of AI.

These results confirm that, although there is interest and willingness to incorporate AI, teacher training remains a key factor for its full adoption (Crompton & Burke, 2023; Jacques, Moss & Garger, 2024).

Regarding the practical application of AI in teaching, the results indicated that:

- Regular use: 40% of teachers apply AI tools consistently, mainly adaptive learning platforms, virtual assistants, and data analysis software.
- It plans to incorporate it: 35% intend to integrate AI soon, pointing to a lack of training or resources as the main limitation.
- They do not use AI: 25% have not adopted AI tools in their practices, evidencing gaps in training and technological access.

This shows that AI is already partially integrated into educational processes, with significant potential for expansion if teacher training programs are strengthened and the availability of adequate technological resources is ensured (Nebieridze & Jojua, 2025; Long, Wang & Lu, 2025).

Regarding the perceived benefits and challenges associated with AI in higher education:

- Benefits: 70% of teachers believe that AI improves the personalization of learning, facilitates immediate feedback, and contributes to the development of academic research.
- Ethical and pedagogical challenges: 60% identified risks related to data privacy, technological dependency and the need for ethical use of tools.
- Teacher training: 55% agreed that continuous training is essential to apply AI effectively and responsibly, avoiding digital illiteracy and ensuring critical competencies in students.

These findings confirm that AI is perceived as a transformative tool, but its implementation requires institutional strategies that include training, ethical accompaniment, and curricular updating (Sanabria-Navarro et al., 2023; Zhou, 2023). The data obtained show that:

1. Most teachers have intermediate knowledge, indicating interest, but also the need for deepening in AI.
2. The application of AI in the classroom is partial, but growing, with prospects for expansion if training and resource barriers are overcome.
3. Teachers recognize clear benefits in terms of personalization, efficiency, and research support, but also ethical and pedagogical challenges that require institutional policies and continuous training.

## Conclusions

The objective of this research was to analyze the impact of artificial intelligence (AI) in higher education, identifying the opportunities it offers for educational innovation and the development of digital skills and critical thinking in students. The methodology used consisted of a structured questionnaire applied to 100 university professors, focused on three dimensions: knowledge about AI, use of AI in teaching, and perception of ethical and pedagogical benefits and challenges. From the analysis of the data obtained, the following conclusions can be drawn:

The majority of teachers (65%) have intermediate knowledge about AI, while 20% show advanced knowledge and 15% limited knowledge. This shows a general interest in the topic, but also underscores the need for continuous training and digital literacy programs that allow for a more effective integration of AI into educational processes (Crompton & Burke, 2023; Jacques, Moss & Garger, 2024).

The adoption of AI tools in university teaching is partial but growing, with 40% of teachers using it regularly, 35% planning to incorporate it, and 25% not yet implementing it. These results reflect that AI is already present in academic programs, although its expansion depends on teacher training, technological infrastructure, and the availability of resources (Nebieridze & Jojua, 2025; Long, Wang & Lu, 2025).

AI is recognized as a tool that improves the personalization of learning, immediate feedback, and academic research, according to 70% of respondents. However, 60% identified ethical and pedagogical challenges, mainly related to data privacy and technological dependence, while 55% emphasized the need for continuous teacher training to ensure responsible and ethical use (Sanabria-Navarro et al., 2023; Zhou, 2023).

The results confirm that artificial intelligence has transformative potential in higher education, by offering new pedagogical strategies, fostering critical thinking and supporting technological innovation. However, its

effective adoption requires clear institutional policies, ethical support, curricular updating and development of digital competencies among teachers and students.

In conclusion, the integration of AI in universities should not be limited to an instrumental use, but should be oriented towards a profound transformation of the educational paradigm, promoting inclusive, personalized and ethical learning that prepares students to face the challenges of an increasingly digitized and automated academic and work environment (Crompton & Burke, 2023; Sanabria-Navarro et al., 2023; Díaz Vera et al., 2024).

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