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Research Article

Pedagogical Methodologies and Approaches Used in the Integration of Artificial Intelligence in University Curricula of Graduate Programs

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ABSTRACT

The study on pedagogical methodologies and approaches used in the integration of AI in graduate program curricula outlines the constant educational evolution that goes hand in hand with new technological advances. However, research in this context faces variables where prospective, rigorous, innovative and realistic thinking is required. Therefore, the objective is to identify the pedagogical methodologies and approaches used in the integration of artificial intelligence in the university curricula of postgraduate programs at the global level, within the framework of professional competencies and learning outcomes. The methodology addresses a bibliometric analysis based on PRISMA 2020, where data from Scopus and Web of Science are analyzed. The results demonstrate the importance of the use of AI in Higher Education Institutions (HEIs) from the creation of tools to the needs of the pedagogical context, in the same way it shows the research gap between Asian and Latin American countries in this context.

Keywords: Integration of artificial intelligence in education, Methodologies, pedagogical in AI, University curricula and technology, Adaptive teaching with AI, Assessment of learning with AI.

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1. Introduction:

AI in educational contexts has been a trending topic, as expressed by Regalado et al. (2024) AI has the potential to be used in different areas of science; in the educational field, it contributes to the automation of administrative and pedagogical tasks, support within the classroom for students and teachers. From here we start to study what methodologies and pedagogical approaches can be attributed to AI within graduate programs in their curricula, since 1956, under the Dartmouth conference, led by John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon, the birth of AI as a field of study is marked, but in these 69 years the boom corresponds to the present; As researchers, we must understand the direction that these issues should take within current and future education systems.

The study adopts a mixed approach, focused on occupying references from 2020 to 2025, it is a cross-sectional temporal analysis, with an explanatory purpose, in addition to a manipulation of observational variables.

The importance of references such as Téllez et al. (2024) are the driving forces behind this study, when I believe that expert AI systems are appreciable for the set of actions and missionary activities of universities, in which, thanks to the automation of administrative and academic processes and tasks, the possibility of providing agile and specialized support to the entire community is sought.

The objective of the research is to identify the pedagogical methodologies and approaches used in the integration of artificial intelligence in the university curricula of postgraduate programs in the global scope, within the framework of professional competencies and learning outcomes. Therefore, the following question arises:
How can universities effectively integrate artificial intelligence into their academic curricula of postgraduate programs, meeting the demands of the labor market and the challenges of technological evolution, to train competent professionals in the digital age?

2. Methodology:

The role of AI in university curricula today is a reality with many deductions, virtues and challenges, especially in ethical terms. It has been shown that the efficiency of decision-making and creativity within students improves significantly with the use of AI in their pedagogical tasks. higher education. Jaimes et al. (2024) tell us that AI is transforming the way we teach and learn, opening up new possibilities for the academic training of university students in health sciences. This is an impetus to carry out a thorough search aimed at evidencing what are the methodologies and pedagogical approaches used in the integration of artificial intelligence in the university curricula of postgraduate programs, at a global level.

2.1. Eligibility Criteria

The inclusion of the texts was based on the analysis of keywords and titles as main data, where variations are observed in the context of the subject of study, terms such as the integration of artificial intelligence in education and university curricula and technology were taken into account, in order to guarantee a broad panorama within the reference literature. For the exclusion phases, documents without full access were not taken into account, nor documents with characteristics other than an article, in order to generate precision in the data analyzed for the construction of the bibliometric research.

2.2. Sources of information

We are inclined to use databases such as Scopus and Web of Science, due to their recognition as the main sources of scientific literature, the University of Valladolid. (2022) highlights that these databases remain within a wide scope of tenacious scientific literature, where there are considerable and varied disciplines, in addition to this, it provides advanced tools for the analysis and visualization of metadata; this makes them indispensable resources for researchers. Therefore, the choice of these two databases

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guarantees us a holistic and representative view of scientific publications of importance for this field of study.

2.3. Search strategy

The following search equations were designed for the databases in question:

For Web of Science database: (TS=("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning" OR "natural language processing" OR "AI applications" OR "AI-based systems" OR "intelligent systems" OR "cognitive computing" OR "AI in education" OR "educational AI" OR "smart technologies" OR "AI tools")) AND (TS=("virtual assistant" OR "intelligent tutor" OR "chatbot" OR "educational chatbot" OR "adaptive learning systems" OR "AI-enhanced learning" OR "digital" tutor" OR "intelligent learning environments" OR "learning technologies" OR "AI-driven tools" OR "virtual learning environments")) AND (TS=("education" OR "higher education" OR "university students" OR "academic learning" OR "student engagement" OR "learning outcomes" OR "teaching methods" OR "educational systems" OR "online learning" OR "digital classrooms" OR "e-learning")) AND (TS=("digital transformation" OR "education technology" OR "technology in education" OR "technology-enhanced" learning" OR "digital tools" OR "digital education" OR "online tools for learning" OR "digital innovation" OR "education innovation" OR "learning technologies"))

For the Scopus database: (TITLE-ABS-KEY("artificial intelligence" OR "AI" OR "machine learning" OR "deep learning" OR "natural language processing" OR "AI-based systems" OR "cognitive computing" OR "intelligent systems" OR "educational AI") AND TITLE-ABS-KEY("virtual assistant" OR "intelligent tutor" OR "chatbot" OR "educational chatbot" OR "adaptive learning" OR "digital tutor" OR "AI-driven education" OR "intelligent learning systems" OR "AI-powered tools") AND TITLE-ABS-KEY("higher education" OR "university students" OR "academic performance" OR "student engagement" OR "learning outcomes" OR "education innovation" OR "online learning" OR "virtual classrooms" OR "blended learning") and title-abs-key("digital transformation" OR "e-learning" OR "online education" OR "technology in education" OR "digital skills" OR "educational technology" OR "technology-enhanced learning"))

2.4. Data Management

R Studio software is used to extract and analyze the information from both databases, according to Kronthaler and Zöllner (2020), R is a fairly powerful open-source statistical package tool for analyzing data and providing publication-ready graphs, R, has become the main statistical software in science and research.

2.5. Selection process

According to the PRISMA 2020 statement, the flowchart shows the flow of information through the different phases of a systematic review. Indicates the number of records identified, included and excluded, and the reasons for the exclusions. (PRISMA 2020 Flow Diagram — PRISMA Statement, n.d.)

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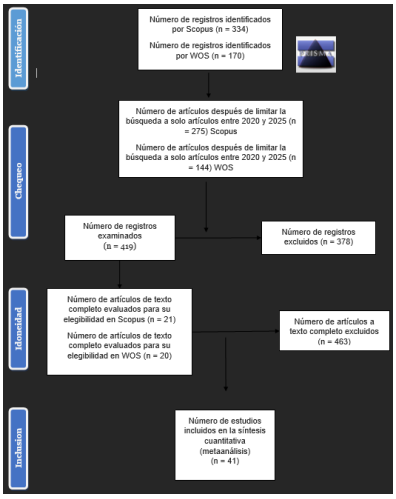

Figure: 1- PRISMA Flowchart

3. Results

The results in bibliometric contexts show a concise evolution of the terms per year that are related to the application of AI in higher education students' curricula, where the term Artificial Intelligence obtains a growth from 5 documents in 2020 to 56 in 2025, making this term one of the dominant ones, but it is not at the top where we have the concept of Electronic Learning with an evolution from 17 documents in 2020 to 124 in 202, with this we find agreement with Marquina et al. (2024) when they tell us that the impact of AI on education has been extensively analyzed, as in the Beijing Consensus, which evaluated its management and support in the field of education (Unesco, 2023), In China, for example, new university careers specifically related to AI have been introduced, reflecting its growing importance.

On the other hand, it is revealed that in the term Chatbots, it is on the right side of the term AI with a growth of 1 document in 2020 to 46 mentions in 2025. All these terms refer to the constant evolution and application of AI within the classroom in HEIs, AI can also change the future of education. (Tlili et al., 2023). An example of this would be as a creative guide for students when analyzing information and shaping a pedagogical product. The evolution of the terms presents an upward trend that promises prospective acceptance by the global educational community.

Board 1: Frequency of words over time

Year	E-learning	Students	Learning Systems	AI	Chatbots	Adaptive Learning	Computer-Assisted Instruction	Online Learning	Higher education
2020	17	10	11	5	1	4	6	1	1
2021	35	19	20	15	5	4	9	5	2
2022	63	34	32	27	16	6	17	20	6
2023	96	53	57	42	28	21	24	30	16
2024	124	84	81	56	46	39	39	38	31
2025	124	84	81	56	46	40	39	38	32

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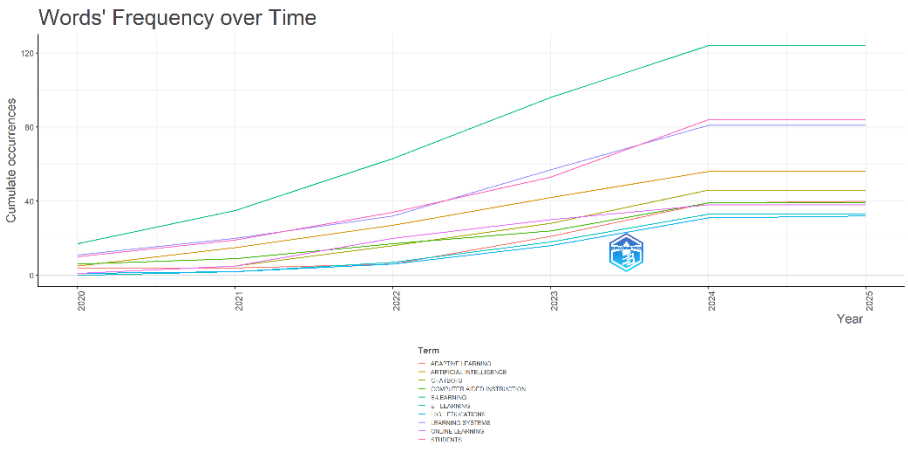

Figure: 2 Frequency of words over time

From a territorial point of view, the countries where the most scientific information has been produced in contexts of AI applied in HEIs are evident, where China is the country with the highest production, with 40 documents, representing approximately 22% of the total, followed by India which has a similar number, with around 38 documents, which is equivalent to 21%. while the United States is in third place with 25 documents, representing 14%; following this in terms of intermediate production, Germany with 15 documents, 8%, the United Kingdom 13 documents, 7%, Spain 12 documents, 7% and Australia 10 documents, 6% maintain a relevant scientific production, although lower compared to the three leaders. According to this information, the "low production" is presented by Malaysia 9 documents, 5%, Egypt 8 documents, 4% and Brazil 7 documents, 4% have a moderate contribution, while Colombia 5 documents, 3%, Chile 4 documents, 2%, Switzerland 3 documents, 2% and Peru 2 documents, 1% are at the bottom of the list with the lowest participation.

China, India and the United States They represent about 57% of total production, which shows a large concentration of publications in these countries. European countries contribute approximately 30% of the total, with Germany and the United Kingdom as the main actors and the Latin American countries Brazil, Colombia, Chile and Peru account for only 10% of the total, evidencing a lower scientific production compared to other regions.

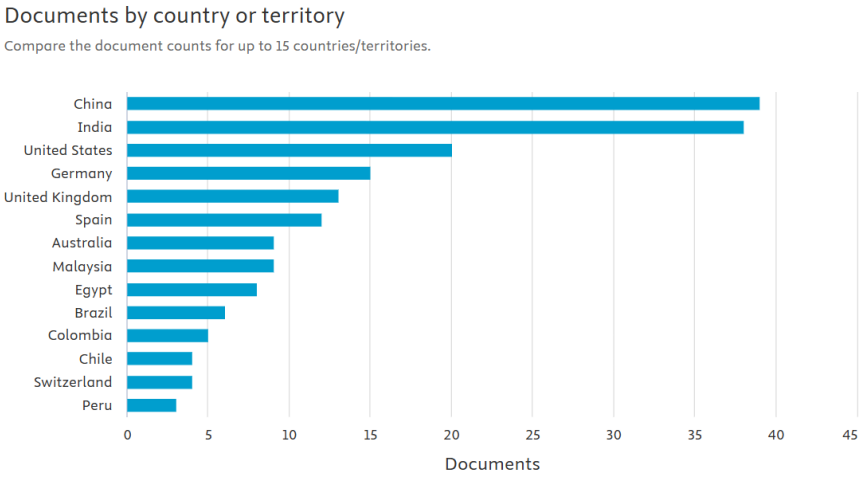

Figure: 3 Documents by territory

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In a second moment from the perspective of 4 categories, in order to identify methodologies and pedagogical approaches used in the integration of artificial intelligence in university curricula and focus them on postgraduate programs, the following are identified:

- Skills and competencies of the twenty-first century in contexts of 4 industrial revolution (AI) including terms where a 5 technological revolution is mentioned.
- Creative impact of Artificial Intelligence on the training of future professionals
- Contemporary research with the use of technological tools such as AI
- Ethical Concerns, Challenges, and Regulations in Teaching

In Marquina et al. (2024), the validation results of the instrument for measuring attitudes towards AI express a variety of dimensions regarding the perception of university students regarding the use of this technology, called emerging. The results suggest attitudinal diversity towards AI, suggesting consistency in measurement instruments as a whole, such as validity and reliability in the use of AI. While in Jaimes et al. (2024) two groups of medical students were asked to make use of AI (Chat GPT) for the construction of a medical diagnosis, with the intention of evaluating whether there are significant values at the time of generating an applicative treatment for potential patients. As results of the research, it can be identified that the group that used AI to generate the treatment presents an improvement in the efficiency of constructions and improvements in medical treatment plans; however, the lack of scientific background in this field promotes the continuity of this type of research; this puts on track the application of AI models in higher education curricula in this contemporaneity.
In Ojeda et al. (2023) the application of AI tools, especially Chatbots such as Chat GPT, presents great advantages for higher education institutions, including teachers and students. From the perspective of educators, AI is one more tool in a toolbox, which can promote creativity for the realization of their pedagogical activities, improving the efficiency of students' learning processes, from this perspective, it is also a valuable tool for data analysis and research construction, and the use from the good or the bad depends solely on the ethics of the person who manipulates. On the other hand, AI as chat GPT can improve students' learning proposals, strengthening the creation of new ideas, the way to structure or categorize key concepts for their education, in the same way the positive aspects of the use of AI depend only on the ethics of the person who manipulates the tool and not on the tool itself.
In Tacuri et al. (2024) in higher education institutions there are issues under analysis such as the arrest of plagiarism, the copying of original ideas in academic texts. These concerns lead to the use of programs such as Turnitin to detect such plagiarism; the study mentions the usefulness of using artificial intelligence tools to stop patterns of identity, similarity or copying of ideas through the use of AI, but they also mention the importance of manual verification of an editor, with this doing an analogous part as has been done for years, which shows that there is fear or bias to the use of AI for these cases. It is proposed that teachers be counselors in the classrooms to promote the appropriate use of these technological tools. The same as suggested by Regalado et al. (2024) but in research contexts.
Now, if we look at the use of AI from the administrative point of view in higher education, Regalado et al. (2024) propose an artificial neural connection model, which allowed them to predict whether or not a student can finish their program in the established time, in that case in 5 years, in the same way that this model powered by machine learning helps decision-making, which tells us that this is an advance to carry out monitoring and prediction in pedagogical and institutional processes. on the other hand, it expresses the need to train teachers and administrators in this type of tool.

León and Rodríguez-Conde. (2024) considers that AI should be a subject that occupies the curricula of students in both basic and secondary education, and in postgraduate programs, although in reality the use of artificial intelligence for evaluation processes is proposed. China is considered one of the countries with the most publications on the application of AI in higher education institutions, followed by the United Kingdom and the US, where AI is considered as a necessary transversal knowledge in basic education as well as higher education, as one more digital competence. It is proposed to enhance

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the skills of students with the use of AI, from the creation of smart classrooms, digital courses managed and directed by AI, where the role of AI is more than an assistant in teaching.

While authors such as Acosta, S. F., and Finol, M. R. (2024). analyze the application of AI in higher education institutions from several perspectives, some of them are planning, organization, direction, control, evaluation, results of 42 surveys show that AI is perceived efficiently in three of the four concepts, where planning is seen as deficient, they state that growth is still needed in this regard. But the rest of the concepts studied show that the link of AI in university curricula is necessary for current generations, as it optimizes their processes and interpretations of the data to be studied, in the same way the study reflects the importance of adopting this type of technology for administration and decision-making within HEIs.

A concept of AI application within postgraduate curricula proposed by Freire-Palacios et al. (2023) is gamification, here we agree gamification with artificial intelligence applications should be involved both in university life and in student curricula, in order to improve the mental health of students, emphasis should be placed on gamification strategies that guarantee positive approaches to mental health, This will help improve users' engagement with learning and socialization processes. This is comparable to what we know today in the use of video games to reduce stress in various contexts, both work and learning; In this way, players are encouraged to interact with content aimed at promoting mental health in their periods of greatest commitment by making good use of leisure or free time.

the creation of training and professional development programs focused on AI in postgraduate contexts is urgently considered, since it has identified that older teachers do not have the same mastery and knowledge of technological tools such as AI compared to younger teachers who have grown up in this technological transition. The integration of AI in university contexts represents an advance hand in hand with the 4th industrial revolution, if it does not do so it is outdated and in this sense the learning programs by universities would be outdated if AI programs are not included in the curricula. (Estrada-Araoz et al., 2024).

Higher education faces challenges that demand advanced technological solutions. Universities are constantly looking to improve the accessibility and personalization of learning. Artificial intelligence, with its ability to process large volumes of data, provides promising tools to transform university education. Automatic video dubbing allows teachers to create accessible educational materials for a global audience, eliminating language barriers. (Aparicio-Izurieta, 2024). Another angle that has been mentioned and is worth repeating is university research, traditionally anchored in conventional methods and approaches, has undergone a revolution driven by AI's ability to process large amounts of data, identify complex patterns and generate predictive insights. (Meza et al., 2024)

The Beijing Consensus on AI and Education confirmed the commitment made in the 2030 Agenda for Sustainable Development. In particular, the fourth Sustainable Development Goal (SDG) and its targets to promote appropriate policy responses in achieving the systematic integration of AI in education were reiterated. The consensus stated that the integration of AI in education should consider teaching and learning innovations. (Calvo-Lavado et al., 2022). AI-enhanced education has made a positive contribution to promoting awareness of sustainable development and global citizenship (Target 4.7, i.e. in all reported practices as well as in practice N◦ 2) by engaging learners in real-world challenges. (Savec & Jedrinović, 2024b).

Now, from an angular perspective, as shown in Table 2, there are relationships between authors that cannot be left out of the results of the research, in the approach of methodologies applied to the curricula of graduate programs, there is an important pattern in expressing that the application of AI has good results and improvements in learning processes when it is incorporated as a pedagogical assistant. the area where it is denoted is the area where AI tools are most used is medicine, in the same way it is a research niche with quite strength as expressed by Jaimes et al. (2024). However, there is a concern on

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the part of teachers who fear being stripped of their role by AI, without thinking about a reasonable transformation of their part more inclined towards the guidance of the human itself. Secondly, it is evident as a result that the benefits of AI can be used in the creation of scientific research by graduate students, due to the ease of information collection and data analysis, here is added a concern for the integrity and care of information, ethical aspects, but these must be anchored more to the human who operates the tool than to the tool itself, as expressed by **Shuliar et al. (2023) and** Molenaar. (2022).

Other and no less important uses for AI in postgraduate curricula are the reduction of language gaps or barriers, as it provides the ease of translating and interpreting in different languages as mentioned in **Miquel-Vergés' research. (2024).**

Board 2: Some curricular applications

Authors	Other Categories
(Téllez et al., 2024) (Alnaqbi & Yassin, 2021) (Garay-Rondero et al., 2024) (Cholyshkina et al., 2024)	Administrative management
(Parra-Sánchez et al., 2023b)	College dropout
(Miquel-Vergés, 2024)	Eliminate language barriers
(Gragera, 2024)	
(Cao et al., 2023)	Ethical Regulations in Teaching through AI
(Molenaar, 2022)	
(Nam & Bai, 2023)	AI in favor of scientific research
(Shuliar et al., 2023)	
(De la Cruz Romero & Ovalle, 2022)	
(Martín-Ramallal et al., 2022)	AI as pedagogical assistants
(Cholyshkina et al., 2024b)	
(Lastrucci et al., 2024)	
(Zhou et al., 2024)	
(Issa et al., 2024)	
(Jia & Tu, 2024)	
(Lázaro & Duart, 2023)	
(Livberber & Ayvaz, 2023)	
(Petruneva et al., 2024)	
(De Freitas Santos et al., 2021)	
(Sathe et al., 2024)	
(Tayan et al., 2023)	
(Ilieva et al., 2023)	
(Essa et al., 2023)	
(Pereira et al., 2023)	

4. Discussion

The discussion section analyzes the results obtained, delves into their significance, considers their practical applications, and recognizes the limitations of the research.

4.1. Analysis of the results

The bibliometric results reveal that the tool most used by higher education students for problem solving, information analysis and creation is Chat GPT, a virtual assistant, this is where we should start to promote the construction of this type of personalized tools for each area of study, so that its data feed is specific to the area that uses it. On the other hand, it is shown that China is a country

with a strong technological development and its students show a high percentage of acceptance in the application of AI in their pedagogical responsibilities. On the other hand, in Latin America, the effort to understand AI processes in HEI curricula is increasing, but there is less scientific information on the subject. León and Rodríguez-Conde. (2024) considers that AI should be a subject for the curricula of students at all levels of training, which is a success to keep pedagogy updated to the current trend.

Another relevant aspect is raised by Cao et al. (2023) and Molenaar. (2022) are the ethical aspects that have to do with plagiarism, distribution of information and safeguarding sensitive data, since the AI instrument could be trained to indoctrinate, for example, or hide data that mobilizes certain behaviors or social thoughts.

The results reveal that the pedagogical methodologies and approaches with the best integration of artificial intelligence in the university curricula of graduate programs are the construction of intelligent scenarios that promote knowledge with AI tools, such as the construction of a personalized learning assistant. In relation to the teaching and learning processes of higher education, according to Ojeda et al., (2022), pedagogical strategies will act as "the channels used for the instruction given by teachers, allowing the generation of the student's cognitive development, potentiating their experience and motivation". These strategies are present in the teachers of the different pedagogical models on which they are circumscribed, whether they are traditional or more active in student learning. The strategies represent excellent opportunities for university teachers to create valuable learning scenarios, allowing students to acquire lasting knowledge that is applicable in practical contexts.

Another of the most important uses is the application of AI to research processes, due to its ease in data analysis, interpretation and multiform creation of concepts. University research, traditionally anchored in conventional methods and approaches, has undergone a revolution driven by AI's ability to process large amounts of data, identify complex patterns, and generate predictive insights. This transformation has not only affected scientific and technological disciplines, but has also permeated the humanities, social sciences, and the arts, redefining the way academics approach their research. (Meza et al., 2024).

The results show that one of the areas with the greatest influence and experience in the application of AI in their curricula is medicine, which appropriates its benefits of automation and machine learning. GenAI's perceived ease of use positively influences students' development of problem-solving skills. The mediating role of self-regulation is understood as a deliberate and flexible process through which students can plan, adjust, and monitor their cognitive, emotional, and behavioral responses to task requirements. It is a crucial component of critical thinking, helping students through complex cognitive processes. (Zhou et al., 2024).

4.2. Limitations and practical implications

The study of the reference literature was based on the PRISMA-2020 methodology, using Scopus and Web of Science as main databases, tools such as R Studio and the Scopus analysis apparatus were used to analyze bibliometric indicators, despite the rigorous process, limitations include the possible omission of distinguished documents that could affect the objectivity of the results.

In the sense of practical implications, concepts were developed that will serve as a starting point for future research:

- Intelligent adaptive learning

AI-based learning that adapts to the needs of users' social, political, and academic contexts.

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- Using Digital Twins in Academic Simulations

This learning model could be included in medicine, finance or administration, for example the use of a virtual patient that can be attended by a robot that learns through AI and is controlled by a doctor who is a student of a specialty, whether cardiology or urology.

- AI as a virtual tutor and academic mentor

Virtual tutors, with all the knowledge of the cloud at their disposal that identifies the student's learning needs and adapts the answers to this, promotes motivation, innovation and scientific research, in the same way promotes the ethical use of their abilities.

- Integrating AI into Academic Research

The creation of research assistants, avatars with the ability to analyze data, create objective, applied and realistic interpretations, identify unethical patterns, promote innovation, directions and efficient solutions.

5. Conclusions

HEIs are experiencing a digital transformation that is running rapidly, Latin America cannot be left behind, academics must balance the research gap in relation to other countries and promote the construction of self-regenerative scenarios for the prosperity of new ideas.

The use of AI is a reality for society in general, we have its presence in everyday applications, where it can be used as an assistant, creator of patterns, even images, just by writing a simple prompt; Now graduate programs can go a little further with the development and use of these elements, in the users of these programs are the ideas that will change the history of education.

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