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FACTORS INVOLVED IN THE INCORPORATION OF ARTIFICIAL INTELLIGENCE IN POSTGRADUATE ACADEMIC PROGRAMS AND ITS APPLICATION IN DIFFERENT CURRICULAR CONTEXTS

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Abstract
In the implementation of technological tools such as AI in postgraduate academic curricula, several factors of holistic sense are faced, these factors operate together in similarity to the structure of everything for everything, so it is important to evidence them to generate new curricular proposals. The study evidences scientific documentation that guides the line of research on AI applied to the graduate curriculum, identifies gaps in access to knowledge and ethical concerns regarding the use of AI. The databases used to locate the reference literature were Scopus and Web of Science, in this same sense R Studio and its Bibliometrix library are used for the storage and analysis of metadata.
Keywords: Artificial Intelligence (AI), Postgraduate curriculum, Technological incorporation in higher education, Curricular factors, Educational innovation.

Resumen
En la implementación de herramientas tecnológicas como la IA en los currículos académicos de posgrado, se enfrentan varios factores de sentido holístico, estos factores operan en conjunto en similitud a una estructura de todo para todo, por lo que es importante evidenciarlos para generar nuevas propuestas curriculares. El estudio evidencia documentación científica que orienta la línea de investigación sobre IA aplicada al currículo de posgrado, identifica brechas en el acceso al conocimiento y preocupaciones éticas respecto al uso de la IA. Las bases de datos utilizadas para localizar la literatura de referencia fueron Scopus y Web of Science, en este mismo sentido se utiliza R Studio y su librería Bibliometrix para el almacenamiento y análisis de metadatos.
Palabras clave: Inteligencia Artificial (IA), Posgrado, Incorporación tecnológica en la educación superior, Factores curriculares, Innovación educativa.

1. INTRODUCTION

When incorporating AI in the contexts of graduate programs, there are factors that intervene in this incorporation, in those curricula, an example of this would be the vision of Regalado et al. (2024) where they propose an artificial neural connection model, which allowed them to predict whether or not a student can finish their undergraduate degree in 5 years, In the same way, he states that this model fed 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. From this example we could select some factors that intervene such as *cultural and organizational factors, pedagogical factors, institutional factors, etc. This interpretation is made in this study, attributing that AI has been immersed in academic programs for 69 years, but not in a "complete way"1956, after the Dartmouth conference, led by John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon, has been part of academic life being almost invisible.*

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 Parra-Sánchez et al. (2023b) are a driving force behind this study, because it has already been put into the task of investigating factors that incur in academic life from the application of AI; the use of AI is proposed to analyze the data of the discovery of factors that affect the dropout of university students, academic factors, factors related to motivation and study habits, institutional factors, economic and sociodemographic factors, now although these factors have been identified, the appropriation of technological tools such as AI to strengthen the academic ties of students and involve them in their curriculum can be inclined programs that reduce, for example, the dropout gap.

The objective of the research is to characterize factors that intervene in the incorporation of artificial intelligence in university academic and postgraduate programs for its application in different curricular contexts. 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, and the factors involved in these applications must be considered. We have shown that the efficiency of decision-making and creativity in students improves significantly with the use of AI in their pedagogical work in higher education. But can these factors improve the capacities of understanding and handling technological tools and the experience of the subjects involved? According to Calvo-Lavado et al. (2022) and the previous mention, it is evident that the application of AI in university environments promotes organizational growth, fosters innovation processes, which are perfectly aligned with the 2030 agenda and its SDGs, however, if we implement these AI systems in the daily life of the school curriculum, we will be encouraging the student to modify their reality and thus create society. It is time to modify conventional classrooms, education is no longer the same as it was 10 or 20 years ago, in the same way spaces and content must be modified, and educators must adapt or step aside.

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, 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 considered, nor documents with characteristics other than an article, 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 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 the 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

The R Studio software was used through its Bibliometrix library 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 to analyze data and provide graphs ready for publication, 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.)
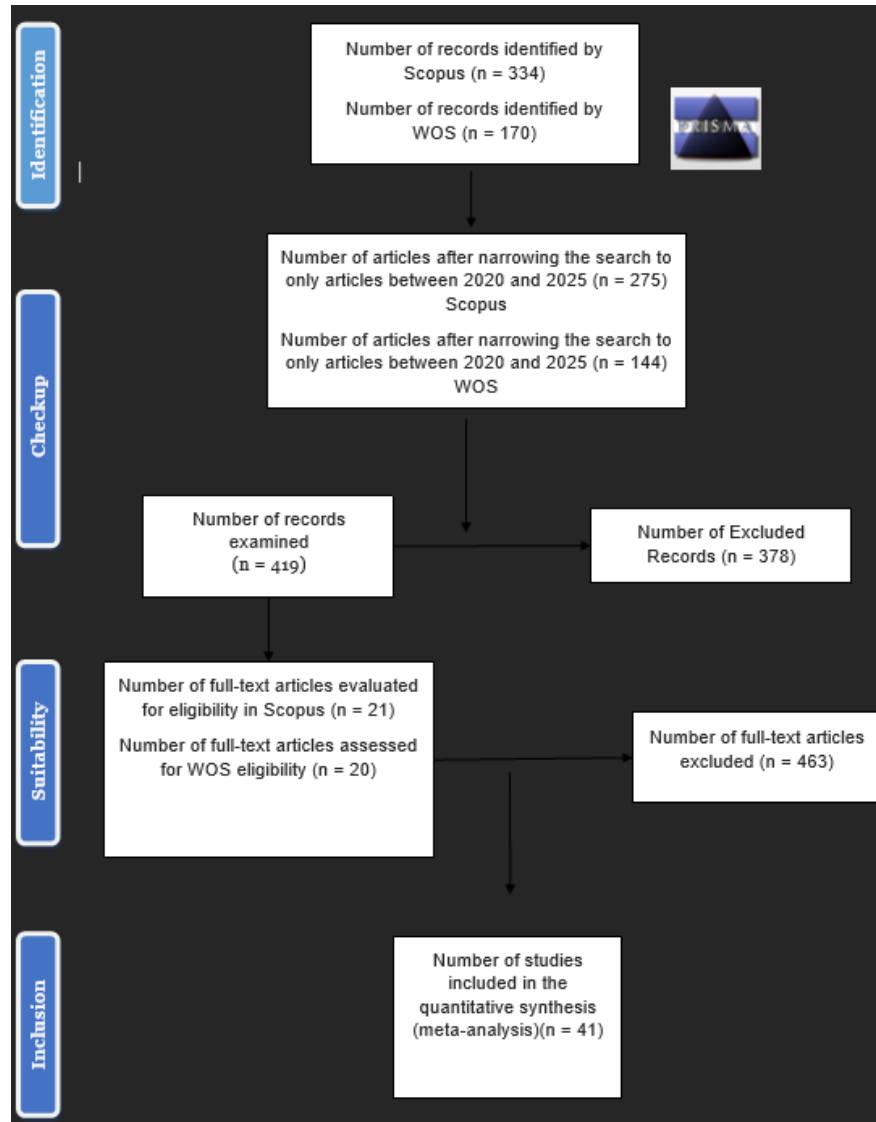
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Figure: 1- PRISMA flowchart

3. RESULTS

In the analysis of the information, the results show 10 factors that have been selected as the main ones, but clearly more of these occur. The interpretation of these factors is organized in a table called *factors and variables*, with the intention of giving order to the estimated data.

In the field of health sciences, AI has proven to be an invaluable tool that enables health professionals to carry out more accurate and faster diagnoses (Jaimes et al., 2024), from this appreciation begins the configuration that shapes *institutional factors*, from a perspective of application of AI in the university curriculum, Evolution is manifested in students at the time of performing their routine procedures. The findings of this research highlight the relevance of the role of institutions in the integration of innovative AI technologies for the training of future professionals. In the same sense of the institutional role, variables such as the creation of educational innovation policies, the availability of technological and financial resources and the indisputable support of academic and administrative authorities stand out.

Now, although the relevance of an institutional factor is described, other factors arise from it, such as:

- Institutional factors
- Curricular factors
- Teaching factors
- Student factors

- Contextual factors
- Technological factors
- Pedagogical factors

- Ethical and regulatory factors
- Cultural and organizational factors
- Impact factors and expected outcomes

In the research by Shuliar et al. (2023) analyze the role of AI in higher education institutions, highlighting here the *curricular factors,* this study is a starting point to mention variables such as program and curriculum design, integration of AI in specific subjects, the study expresses the outstanding opportunity of personalized learning, although in the same way there is concern about the lack of training for teachers in this technological context; which leads to *the teaching factors* and their variables such as training and training in AI, their perception, attitude and disposition towards technology and finally their technological or digital skills.

Hand in hand with the teaching factors, there is the *student factor*, here we must consider the perception and acceptance of AI in learning, by higher education students, on the other hand diagnose their level of preparation in technological tools and their expectations and academic needs. Cholyshkina et al. (2024) convince us of the improvement made by AI in its application to virtual reality, in the same way as to other immersive technological tools, learning environments are created that promote imagination, curiosity and facilitate the understanding of complex concepts.

A clear example of *pedagogical factors*, pedagogical and digital transformation and innovative didactic approaches can be found in Alnaqbi & Yassin (2021) in their research *Current Status, Challenges and Strategies of Artificial Intelligence and E-learning the UAE Military Education System,* here he shows us how military forces such as that of the United Arab Emirates are beginning to transform their pedagogical and teaching realities. because officers cannot receive constant training in a traditional precinct, they addressed the difficulty with remote learning aided by AI, with an immersive experience that leads officers to learn from their needs in favor of the constant evolution of their knowledge.

Jia & Tu (2024) allows us to address *contextual factors and technological factors,* from this perspective it is understood that universities, in this case graduate programs are resource units for AI, that is, they are the appropriate space for the research and application of these tools, it is stated in the research that the hypothesis is confirmed by indicating that AI capabilities improve general self-efficacy, personal and individual motivation, while creating an awareness of critical thinking aimed at understanding new learning perspectives. In relation to the above, universities only need to invest in appropriate technology to complete the context.

From another perspective, Livberber & Ayvaz (2023) talks about *ethical and regulatory factors*, exposing relevant points such as data protection, transparency in the use of AI, and how to avoid digital divides and ensure equal access to AI tools. From an ethical point of view, they state that tools such as ChatGPT are conducive to support in research and in the classroom, but they express a concern in the direction of plagiarism and misinformation, however, guaranteeing the reduction of a digital divide is within the reach of this tool, since it lends it to anyone with a mobile device or computer; It is believed that the evolution of the Educational Mechanism should be taken into account in the long term in order to evaluate its effectiveness and benefits for education. Based on the above in ethical aspects, the *cultural factor* fits perfectly, let's see it from the perspective of Parra-Sánchez et al. (2023b), these researchers urgently consider the creation of training and professional development programs focused on AI, since they have identified that teachers of advanced ages do not have the same mastery and knowledge of technological tools such as AI compared to younger teachers who have grown up in its technological transition. The integration of AI in postgraduate contexts represents an advance, hand in hand with the 4th industrial revolution, not doing so is being outdated and in this sense the learning programs by universities would be outdated if AI programs are not included; This expands the boundaries of teaching and learning and breaks the challenge of the existence of professionals not trained in technological tools related to artificial intelligence due to cultural and ideological resistance.

The context of *impact factors and expected results* are measurable from their perspective. The planning and design of teaching, in the evaluation and tutoring of the student, in the curricular content, integrating it into the creation of smart campuses and computer laboratories. (León & Rodríguez-Conde, 2024)

> In 1976, the first article on AI applied to Education was published in Scopus. Until 2010 there has been an average of 1.2 articles per year. From 2011 to 2020 a total of 12.7 articles per year, and from 2021 to 2023 there has been an average of 69 articles per year (Bolaño-García & Duarte-Acosta, 2023). León & Rodríguez-Conde (2024).

Table 1: Factors and variables

Factors involved in the	Authors

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incorporation of AI in postgraduate curricula	Variables arising from these factors in application	
Institutional factors	• Educational innovation policies • Availability of technological and financial resources • Support from academic authorities	(Aparicio-Izurieta, 2024) (Estrada-Araoz et al., 2024) (Lázaro & Duart, 2023) (Miller, 2022) (Téllez et al., 2024) (Tayan et al., 2023)
Curricular factors	• Program and Curriculum Design • Integration of AI in specific subjects	
Teaching factors	• AI Education and Training • Attitude and disposition towards technology. • Digital skills	
Student factors	• Perception and acceptance of AI in learning • Level of preparation in technological tools • Academic expectations and needs	(Cao et al., 2023) (Freire-Palacios et al., 2023) (Marquina et al.,2024) (Miquel-Vergés, 2024)
Contextual factors	• Adaptation to different areas of knowledge • Labor Market Requirements • Collaboration with the productive and technological sector	
Technological factors	• Digital infrastructure • Access to AI tools • Technical support	(De la Cruz Romero & Ovalle, 2022) (Ilieva et al., 2023) (Lastrucci et al., 2024) (Sathe et al., 2024)
Pedagogical factors	• Innovative teaching approaches • AI-based automated assessment and feedback systems. • Personalization of teaching	(Inga et al., 2022) (Pereira et al., 2023) (Meza et al., 2024) (Nam & Bai, 2023)
Ethical and regulatory factors	• Data protection • Transparency in the use of AI • Avoiding digital divides and ensuring equal access to AI tools	
Cultural and organizational factors	• Resistance to change • Culture of innovation • Integration of different areas of knowledge for the application of AI in diverse contexts	(De Freitas Santos et al., 2021) (Essa et al., 2023) (Garay-Rondero et al., 2024)
Impact factors and expected outcomes	• Assessing the impact of AI on learning and skills development • Encouraging AI-based research projects • Application of knowledge in real projects that respond to social and productive needs	

It is worth identifying which authors are the most relevant or those who have the most publications in this direction, since this is an indicator that the nobility and acceptance of the research topic is our context.

Alam Ashraf, associated with the Indian Institute of Technology Kharagpur (IIT Kharagpur), ORCID https://orcid.org/0000-0001-6178-1187, stands out from other authors for the volume of citations presented by his publications per year, in 2022 with his research *USE OF ADAPTIVE LEARNING AND INTELLIGENT TUTORING ROBOTS FOR VIRTUAL CLASSROOMS AND SMART CAMPUSES: REFORMING EDUCATION IN THE ERA OF ARTIFICIAL INTELLIGENCE*, with respective Doi 10.1007/978-981-19-2980-9_32, obtains a TC of 123 and a TCPY 30.750, this opens a favorable panorama in terms of thematic reception, it does not show that there are many researchers

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interested in the topic of the inclusion of AI in classrooms, whether they are basic, professional or postgraduate education; it is worth mentioning that these data are obtained from Bibliometrix, through R Studio.

Secondly, we find another study by the same author but in the year 2023, called *HARNESSING THE POWER OF AI TO CREATE INTELLIGENT TUTORING SYSTEMS TO IMPROVE THE CLASSROOM EXPERIENCE AND LEARNING OUTCOMES,* with Doi 10.1007/978-981-99-1767-9_42, this reference has a TC of 33 and a TCPY of 11,000, it is this specific study that corroborates a concept that we have been dealing with when it tells us: adaptive learning is a form of technology-based learning that adjusts to the student's learning style, pace, and progress, (Alam, 2023). We are convinced that the future of education is disruptive, it adapts to new technologies, just as classrooms, curricula and learning strategies must be adapted.

The second author was Mansouri Khalifa, deputy director in charge of training and director of the M2S2I Research Laboratory at Mohammedia's ENSET, Hassan II University of Casablanca, with ORCID https://orcid.org/0000-0003-2242-0973, his publication *EFFECTIVENESS OF AN ADAPTIVE LEARNING CHATBOT ON STUDENTS' LEARNING OUTCOMES ACCORDING TO THEIR LEARNING STYLES,* with Doi 10.3991/ijet.v18i13.39329 it is indicated in second place by Bibliometrix with a CT of 19 and a TCPY of 6,333. the size of these two researchers is a promoter for future research in this same line of research, they provide the impetus to try to reduce gaps in current education, according to DANE (2025) in Colombia only 63.9% of Colombian households have internet, this reflects the inequality in terms of connection that this country faces, just taking it as an example.

An educational difficulty that should be thought of from postgraduate research laboratories may be, for example, access to connectivity, equipment and digital skills in Latin America, according to ECLAC in 2022:

- In 8 out of 12 countries in the region, more than 60% of the poor population under 18 years of age does not have connectivity, in 3 countries more than 80%.
- The type of access device also affected educational continuity: a cell phone is not the same as a computer.
- The insufficiency of equipment leads to digital overcrowding, even in connected homes.
- Another barrier was the insufficiency of digital skills among students and educational communities in general. (DANE, 2022)
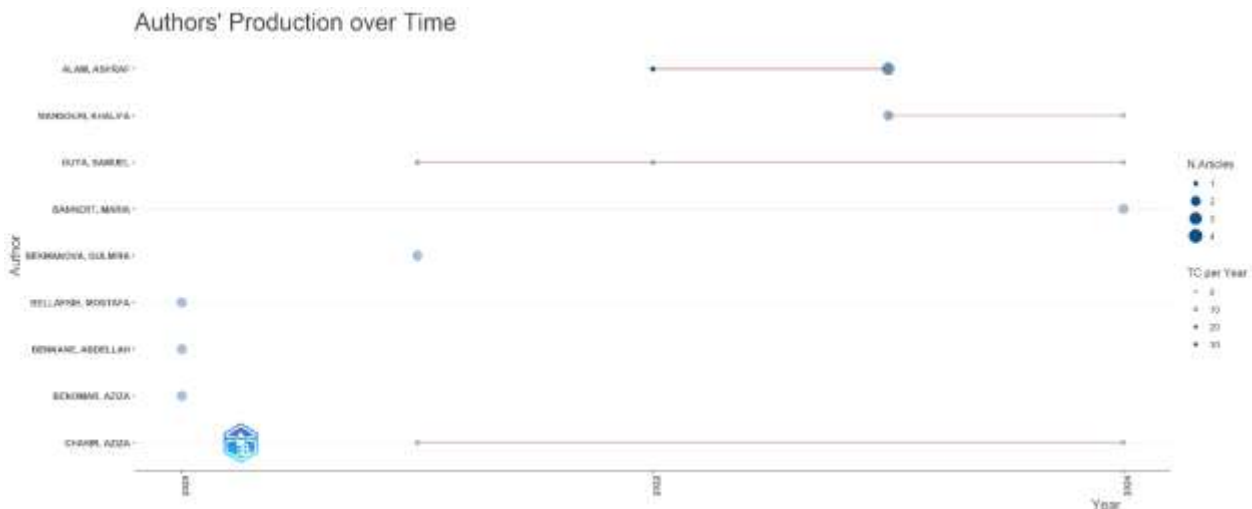

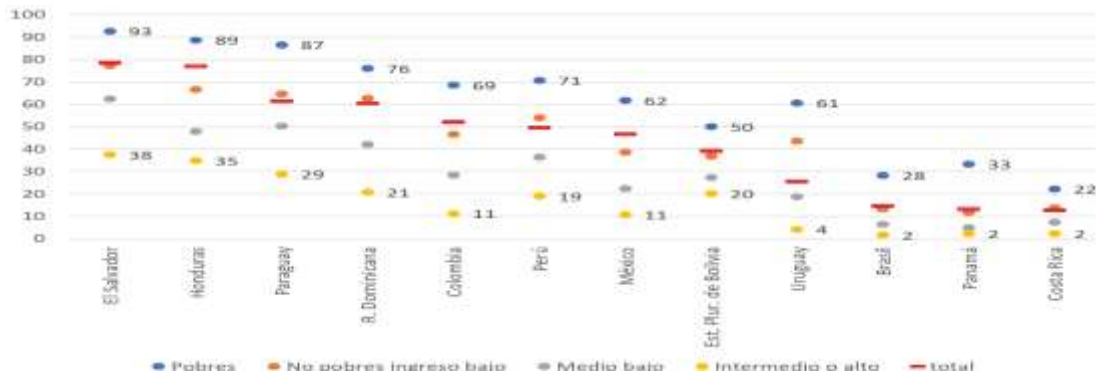*Figure 2: Production of authors over time*

Figure 2: Percentage of children under 18 years of age in households without an Internet connection. Source: BADEHOG, ECLAC Household Survey Databank

The results section aims at examining the trending themes identified in the reference literature, to identify application trends for improvement in graduate curricula and at the same time compare them with the factors already identified.

It is implausible not to promote the fulfillment of the 2030 agenda and the SDGs through AI tools in the implementation within school curricula for HEIs, this encourages students to work towards solving the challenges that affect their community and society in general, encourages innovative thinking, allows students to relate to global problems in terms of justice, human rights and ethical and social agents, in such a way as to promote digital citizenship with responsibility.

> 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)

Having this introductory part for the trending topics, we relate to the topic E-learning, with a frequency of 124, suggesting relevance in the reviewed biography, in this same direction it gained relevance in 2021 by being named in Q1 journals, having greater impact in 2022 and having a final period of relevance in 2023.

The term students are related to Martín-Ramallal et al. (2022), in their research *Virtual trainers with artificial intelligence: degree of acceptance among university students,* tells us that gamification can be a transmission tool at all levels, including postgraduate education, the game excites, even dramatizes work, and thus generates greater motivation. The term Students has a frequency of 84, an important relevance in Q1 journals in 2022, a greater impact in 2023 and a relevant purpose for 2024 in Q3 journals.

Finally, it is evident that the terms found in the metadata analysis of the referring literature are directly related to the impact factors. This is in line with the research by Gragera (2024), *Perception of university students on the effectiveness of Artificial Intelligence in learning English,* The study demonstrates the relevance of involving AI tools in the learning of a second language within a university environment, promotes the integration of a better lexicon, expanding an unprecedented conceptual panorama.

As well as confirming its meaning in relation to the research of Issa et al. (2024), the study also analyzes the perception of students in relation to the application of AI tools in their education, being either favorable result and connected to the findings in this study, speaking from the factors that intervene in this educational context and the use of AI. The study identified several challenges in the adoption of AI in medical education, including a lack of expert training, a lack of knowledge about AI, and a lack of interest in the technology. In addition, a percentage of students surveyed expressed concerns about the impact of AI on patient confidence in the healthcare system, while only a small percentage expressed concerns about replacing healthcare professionals with AI.
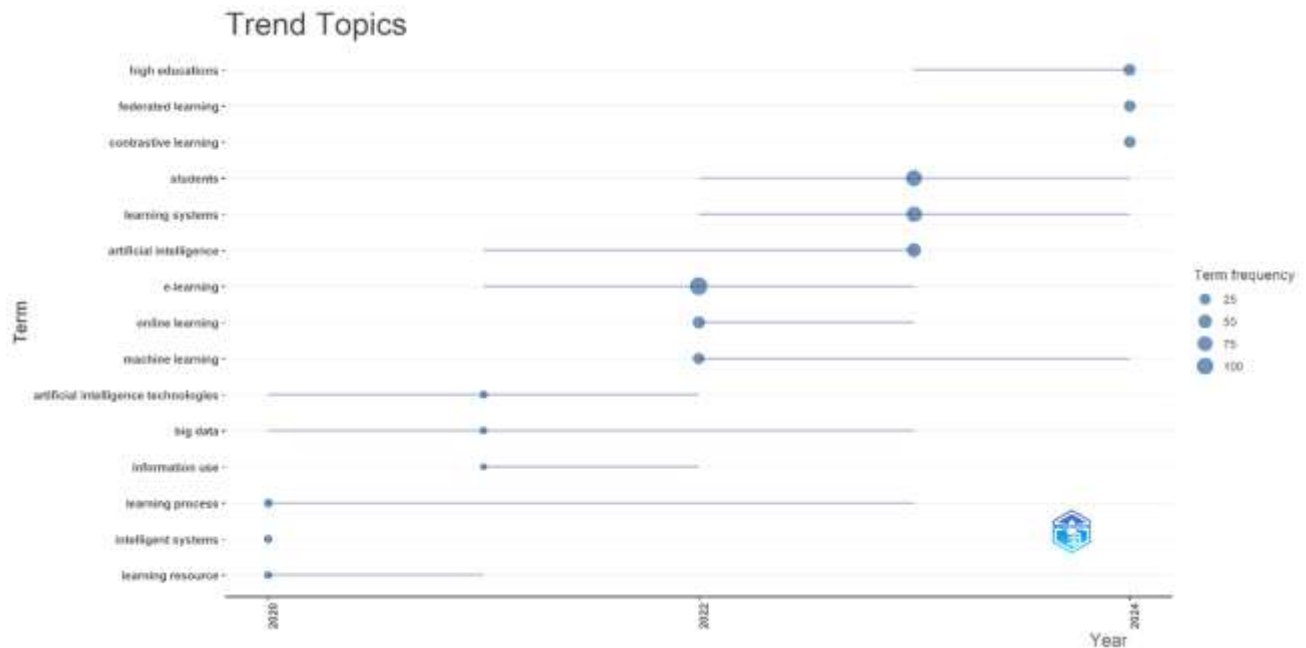
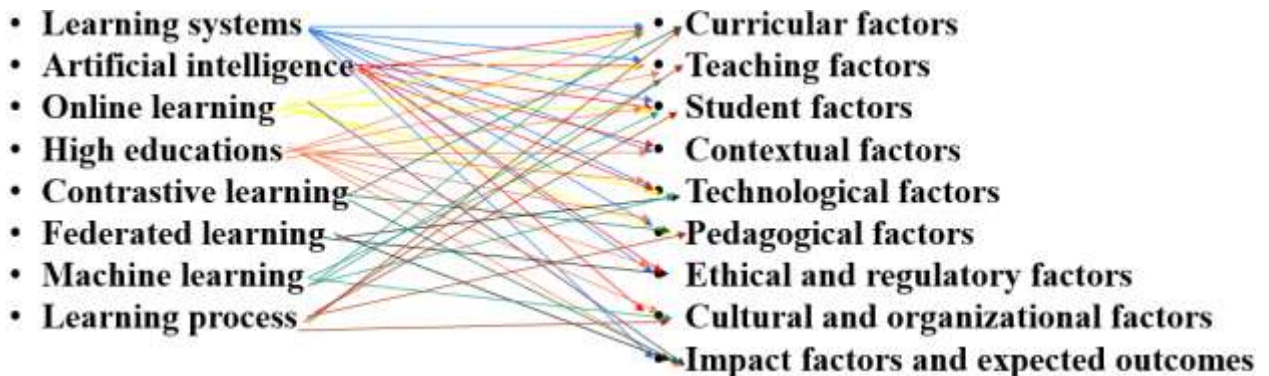*Figure 3: Trending topics, obtained from Bibliometrix*

Figure 4: Relationship between trending themes and factors found, own creation

4.   DISCUSSION

The section called discussion was built with the intention of analyzing the results obtained, deepening their meaning, at the same time relating the results and naming the existence of gaps, in addition to considering their practical applications and recognizing the limitations of the research.

4.1.   Analysis of the results

The results show that the *factors involved in the incorporation of artificial intelligence in postgraduate academic programs and its application in different curricular contexts,* are based on concepts that contain a relationship between the application of AI in postgraduate curricula and education in general, it is evident that there is a gap between communities in connectivity issues, as shown by DANE (2025), but education must be maintained in processes of constant innovation, just as future research must be formulated in the sense of how to contribute to the reduction of these same gaps.

These factors are connected to each other, that is, they are structured among themselves and start in the same sense, all could be established in a common factor that could be the major curricular factor, technological factors, focused on issues of technological architecture, technological capacity and training of personnel in technological trends plays an important role in monetary contexts, it is considered by researchers as an investment issue and there may be interest

from individuals who divert the relevance of these investments in universities or in public policies willing to contribute to the development of the same institutions.

In the second instance, the finding of relevant authors on the subject is necessary for the start of future research, authors such as Alam Ashraf and Mansouri Khalifa and their contributions in the research of AI implementation within educational programs are the north for a future review article, this direction clearly identified with knowing perceptions of what awaits future graduate students and teachers. This appreciation is related to Zhou et al. (2024) and Acosta et al. (2024), their research emphasizes the importance of designing AI tools from scratch that promote self-regulated learning in students, teachers or administrators, without thinking about depending solely on its functionality, it should be thought of in a deeper use, Promoting in the being more than critical thinking, influencing the creation of innovative content, which has the ability to solve contextual problems that deserve it and are personalized to the context. It also focuses on the need for educators and developers of these technologies to integrate strategies that reinforce Self-Regulation within learning environments to maximize their impact on students.

In a final point of view, the issues most highlighted by the R Studio and Bibliometrix software should also be taken into account for the construction of possible curricular policies, since they have the current and futuristic approach for the creation of curricular content in the use and application of AI, the term Learning systems manifests a connection with all the factors identified, what could be called a term of greater influence, this relates it to the research of Tacuri et al. (2024) in the face of concerns in higher education institutions, in topics of analysis such as the arrest of plagiarism, the copying of original ideas in academic texts could affect or not the application of AI in these curricular processes.

4.2. Limitations and practical implications

The study used reference scientific literature located in Scopus and Web of Science as main databases, using a specialized search equation, but this does not adopt 100% of the literature, which implies not recognizing important information for the study, for the analysis of the information tools such as R Studio and its Bibliometrix library were used. Despite the rigorous process, other software could perform this analysis in a more concrete way, this could be another limiting factor for the systematized review.

In the sense of practical implications, there should be an analysis of concepts that are already handled in HEIs in curricular contexts of postgraduate programs, that is why a future research is proposed with the application of surveys to directors, researchers and teachers, in view of their perception, of the use of AI tools in their administrative processes. of learning and evaluation, this in national contexts, taking Colombia in a general way regardless of the university or region.

5. CONCLUSIONS

The global educational community is being part of an imminent technological transformation. Institutional directors of graduate programs and the institution in general must be in frequent with new discoveries and their applications, while aligning their processes and tools to the SDGs.

The use of AI is a reality for the educational community, this is evidenced by:

AI tools can be adjusted to the individual needs and abilities of students. However, there are also concerns about how AI could affect education. For example, some fear that AI could replace teachers and reduce human interaction in classrooms. Similarly, there are currently concerns about how student data will be used and whether student privacy will be adequately protected. The use of natural language processing and generative AI that is based on deep learning has allowed Chat GPT, an AI capable of producing human-like text and maintaining a conversational style that allows for more realistic natural dialogues (Ojeda et al., 2023).

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