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Strategic Foresight of the Post-Pandemic University Student

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Abstract

This study aims to identify the prospective traits derived from academic practices during the pandemic, which led to new forms of learning. In line with the research intention, a non-experimental descriptive-prospective design was chosen, identifying variables distributed across four sectors within a plane of direct and indirect influences. The study was conducted with a sample of 105 undergraduate and graduate university students from 21 universities in Peru, intentionally selected. To identify the variables, an open-ended questionnaire was used, from which two traits emerged: collaborative communication (40 variables) and pedagogical practice (49 variables). These traits were assigned indices and labels of 0 (no influence), 1 (weak), 2 (medium), and 3 (strong). Subsequently, a reflective analysis was conducted, and decisions were made by the study's responsible parties. The results obtained through the MicMac method, and the path model revealed that collaborative communication reflects the use of ICT in tasks, the application of Big Data, the use of AI, group work, ubiquitous learning, the use of artificial intelligence, and ease in handling digital tools for communication. Additionally, pedagogical practice is influenced by the frequent use of links, the development of investigative competencies, the use of digital laboratories and virtual simulators, as well as the incorporation of robotics into learning.

Keywords: *Future scenarios, Digital competence, University, student, Collaborative communication, Pedagogical practice.*

Introduction

Uncertainty has sparked increased interest in the use of technological tools among university students. This necessitates the implementation of pedagogical strategies that strengthen the digital competencies of both educators and students, to meet the demands of current and future knowledge. Prospective scenarios, marked by uncertainty, vary according to the educational policies of each country. However, in a knowledge-based society, access to technology, students' expectations, and academic preparation create a context of constant change. This calls for adaptability in facing new challenges related to learning, interaction with technology, and future employment. According to (Godet et al., 2000), strategic foresight enables organizations to anticipate changes and thereby strengthen their positioning. Similarly, Espinal et al., (2020) Highlight the influence of critical factors in the implementation of improvement strategies for the benefit of society.

From an institutional perspective, (Chung, 2014) Points out that long-term scenario analysis enables organizations to make informed decisions and adopt a more proactive stance. According to (Mora & Morales, 2023), prospective planning is essential for the continuous evaluation of strategic pillars such as teaching, management, research, and social engagement, facilitating adaptation to ever-changing environments. In the social sphere, (Cieśla & Macioszek, 2022) Highlight that academic mobility and mentoring foster new expectations in the development of research competencies. From a psychological perspective, (Balla et al., 2025)) assert that technology has transformed mental health care, allowing for more effective interventions in psychological crises exacerbated by factors such as the pandemic. These crises demand innovative solutions, making it crucial to analyze how technology can effectively prevent and address them.

Strategic foresight, derived from the Latin prospect are (to look ahead), is a key tool in institutional decision-making, as it allows for visualizing the future across various domains. Its primary aim is to anticipate change and ensure that actions are aligned with long-term objectives (Cieśla & Macioszek, 2022; Godet et al., 2000). In

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this context, (UNESCO, 1998) emphasizes that 21st-century higher education must promote innovative strategies that respond to the demands of the labor market and ongoing technological evolution.

The purpose of this study was to identify the main characteristics of the post-pandemic university student in a context of uncertainty. This focus is justified by the need to understand how isolation has transformed educational dynamics and students' expectations. From a theoretical standpoint, the study is grounded in the concepts of adaptation and resilience, analyzing how students responded to imposed educational changes while seeking new practices that enhance the student experience and the quality of education in an increasingly virtual learning environment within the new educational normal.

The main findings of the research are reflected in collaborative communication, which is essential for learning and interaction within the academic community. The use of digital tools enhances the diversity of perspectives, teamwork, and the resolution of complex problems, thereby strengthening professional networks and preparing students for the labor market. Pedagogical practice at the university plays a key role in professional training, integrating prospective approaches that respond to educational and occupational changes. Curriculum innovation, the development of competencies aligned with market demands, and the inclusion of digital technologies are fundamental aspects of an adaptive and inclusive education.

In line with collaborative communication as a strategy for foresight

The analysis of collaborative communication made it possible to identify four key components:

a) Social interaction through ICT during the learning process has generated communicative and social acts that strengthen bonds between users. These interactions foster group dynamics, facilitate the expression of emotions, and reinforce social connections across various contexts (Saldaña & González, 2022). b) Promoting the use of technological tools in learning involves not only ensuring accessibility but also encouraging a culture that values integration across different social settings (Blaszko et al., 2021). c) social interaction after the period of isolation brought emotional and adaptive challenges, leading to a reconfiguration of interpersonal relationships. A decline in mutual support and a rise in social conflict have been observed (Quirama et al., 2023). d) social change driven by technology is a transformative force in human relationships. Its humanistic use enables progress in the professional sphere and the global transmission of culture (Márquez, 2021).

Regarding pedagogical practice within the strategic foresight framework

Following the sequence described, pedagogical practice comprises six variables, according to the report generated by the Cross-Impact Matrix Multiplication Applied to Classification (MicMac) software: a) Academic efficiency through Information and Communication Technology (ICT) refers to the integration of technological tools into the teaching-learning process, with an approach that effectively enhances pedagogical practice. (Espinoza, 2018). b) Disruptive processes through the use of ICT in learning transform user behavior by offering new forms of interaction and learning within educational environments (Cruces, 2017). c) The futuristic university encompasses architectural innovations aimed at modernizing higher education and responding to current market demands (Carbajal-Amaya, 2020). d) The risks and benefits of ICT use highlight that, while ICT facilitates communication and learning, it can also lead to disadvantages such as excessive dependency (Plaza de la Hoz, 2018). e) Professional foresight through ICT use in the labor market requires proficiency in English, information systems, and the application of human values within professional practice (Sepúlveda & Perezchica, 2022). f) The adoption of post-pandemic learning strategies, according to (Aguirre et al., 2023), were tailored to meet student needs and include: i) Cognitive strategies: Information selection, note-taking, and the use of diagrams and outlines. ii) Metacognitive strategies: Planning, monitoring, and evaluation of the learning process. iii) Resource management strategies: Motivation, time management, and the use of online tools.

Materials And Methods

The study identified key, conflictive, and past variables within the university academic setting. According to (Gómez & Armijos, 2017; Inche & Chung, 2014), the research follows a structural analysis with a non-

experimental, descriptive–foresight design. To identify variables, a questionnaire based on Strategic Foresight (INTEF, 2017) was used, consisting of four open-ended questions and ten sub-questions. The analysis of responses, conducted through a matrix, allowed for the identification of two main components: collaborative communication and pedagogical practice. A total of 40 items were assessed for collaborative communication and 44 for pedagogical practice, using a scale from 0 (no influence), 1 (weak), 2 (moderate), to 3 (strong).

Instrument validity was confirmed with an Aiken's V coefficient of 0.85, a Cronbach's Alpha of 0.931, a Kaiser-Meyer-Olkin (KMO) sampling adequacy index of 0.982, and a Bartlett's test of sphericity ($\chi^2 = 4731.71$; $p < 0.001$). The study employed a non-probabilistic purposive sampling method, comprising 105 undergraduate and postgraduate students from both public and private universities.

Table 1: participants in the study

University Public/Private	University	p%	Participants	p%
U. pblic	13	61.90%	75	71.43%
U. private	8	38.10%	30	28.57%
Total	21	100%	105	100.00%

The sample included students from public universities (61.9%) and private universities (38.1%). Of these, 71.43% and 28.57%, respectively, participated in the study. The selection criteria included undergraduate and postgraduate students, all of whom participated voluntarily and provided informed consent. The analysis was conducted in two phases. First, the MicMac method (Godet, 2007) was applied, allowing variables to be placed into quadrants and their foresight influence to be analyzed. Researchers and experts categorized responses and identified causal relationships, which were represented through influence maps and path diagrams. (Hernández, 2016).

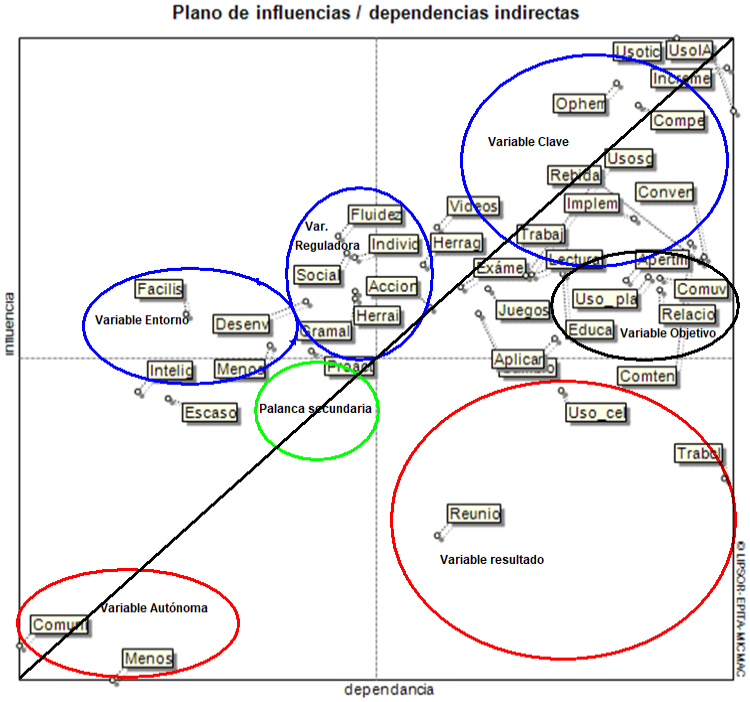
Results And Discussion

The analysis of data organized within the influence–dependence matrix, using MicMac software, revealed 100% direct and indirect incidences, as reflected in the influence diagrams. According to (Godet, 2007), the variables are distributed across four quadrants: conflictive or key variables (Quadrant I) exhibit both high influence and high dependence, making them unstable and capable of altering the status quo; power variables (Quadrant II) possess high influence and low dependence, allowing them to affect other variables and facilitate evolutionary strategies; autonomous variables (Quadrant III) have low influence and low dependence, representing past practices with minimal impact on the system; and outcome variables (Quadrant IV) show high dependence and low influence—although their impact is limited, they are essential for optimizing the system. The strategic positioning of each variable results from the sum of its motricity (influence capacity) and dependence. According to (Cevallos et al., 2021), the influence matrix employed in MicMac software is divided into the Direct Influence Matrix (MID), which describes the influence relationships among variables that define digital literacy, collaborative communication, and pedagogical practice, and the Matrix of Potential Direct Influences (MIDP), which represents both current and potential dependencies between variables. The analysis procedure included: (a) data entry and assessment using the software; (b) generation of visual reports based on the location of variables; (c) determination of strategic value by summing motricity and dependence; (d) identification of influence relationships in the MID; and (e) evaluation of influences and dependencies in the MIDP. The following section presents collaborative communication variables, structured through codes that enable the systematization of interaction among participants in digital environments.

1. Facilitation (Facilis)
2. Conventional, direct, and fraternal (Conven)
3. Increases the use of applications (Increme)
4. Online games with peers (Juegos)
5. Violent and fast communication (Comuni)
6. Virtually connected (Relacio)
22. Virtual education (Educa)
23. Adapted to opportunities (Desenv)
24. Communication through virtual reality (Comuv)
25. Less face-to-face interaction (Menos)
26. Socially and culturally enriching (Social)

7. Use of virtual platforms (Uso_pla)
8. Digital competencies (Compe)
9. Use of smartphones (Uso_cel)
10. Frequent meetings (Reunio)
11. Less tolerant (Menos)
12. Limited social interaction (Escaso)
13. Ubiquitous work and learning (Trabaj)
14. Use of Grammarly, ChatGPT, PDF (Gramal)
15. Videos and artificial intelligence (Videos)
16. Online exams and homework (Exáme)
17. Use of gamification tools (Herrag)
18. Tools for research (Herrai)
19. Individualistic, autonomous (Individ)
20. Automated actions (Acción)
21. Implementation of simulators (Implem)
27. Social and emotional intelligence (Intelig)
28. Communication fluency (Fluidez)
29. Use of simulators and guides (Ususg)
30. Use of ICTs in tasks (Usotic)
31. Opening of new markets (Apertm)
32. Use of AI (UsoIA)
33. Changed my personality (Cambio)
34. Proactivity (Proact)
35. Apply what was learned (Aplicar)
36. Reading virtual books (Lectura)
37. Collaborative work (Trabcl)
38. Communication via technological media (Comten)
39. Optimization of information (Opherr)
40. Frequent use of Big Data (Rebida)

Figure 1: Influence and Dependency Map of the Study



Source: Author's creation in MicMac software.

The description of the variables identified in the quadrants, according to the positioning proposed by (Godet, 2007), is as follows. In Quadrant I, the Objective Variables include openness to new labor markets, virtual academic communication, and access to digital tools, reinforcing virtual education. Alongside them, the Key Variables, located in the upper-right area, encompass the use of artificial intelligence, Big Data, and gamification, solidifying educational digitalization.

In Quadrant II, the Regulatory Variables ensure the fulfillment of the Key Variables through communicative fluency, autonomous information search, and interaction within virtual communities. However, automation may mechanize these interactions. These also include research practice and the use of tools such as ChatGPT

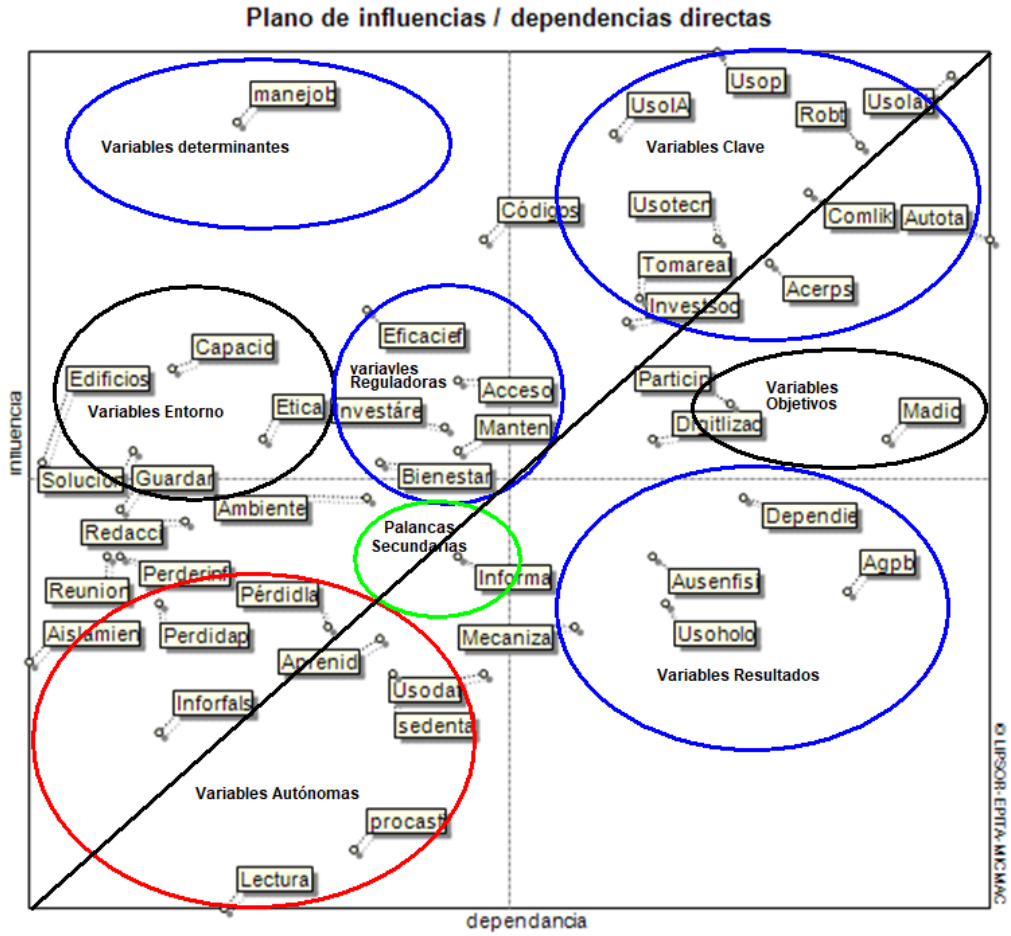
and Grammarly. Environmental Variables, in turn, facilitate access to information and digital interactivity, although they foster dependence on virtual environments and reduce face-to-face interaction.

In Quadrant III, the Autonomous Variables correspond to declining trends, such as violent communication and limited social interaction. The Secondary Leverage Variables, positioned below the Regulatory Variables, drive the evolution of the Key Variables, highlighting proactivity as an essential element. Finally, in Quadrant IV, the Outcome Variables have low motricity and high dependence. These include recurrent meetings, the use of smartphones, and collaborative work, emerging as a consequence of prior processes, such as data collection and pedagogical practice.

Similarly, the pedagogical practice variables are presented through codes that enable the systematization of interaction among participants in digital environments.

1. Database management (manejob)
2. Language learning (Aprenidi)
3. Procrastination (procasti)
4. Ability to analyze and synthesize (Capacid)
5. Scientific writing in different styles (Redacci)
6. Online meetings (Reunión)
7. Research in different areas (Investáre)
8. Save classes for review (Guardar)
9. Use of prompts in AI (UsoIA)
10. Codes to run programs (Códigos)
11. Smart and autonomous buildings (Edificios)
12. Maintenance of non-technological spaces (Manten)
13. Environments in contact with nature (Ambiente)
14. Research on social problems (Investsoc)
15. Social and emotional well-being (Bienestar)
16. Use of holograms (Usoholo)
17. Technological ethics (Ética)
18. Digitization of processes (Digitlizac)
19. Solution to social problems (Solucion)
20 Access to platforms and resources (Acceso)
21. Timely information (Informa)
22. Job loss due to complacency (Pérdidla)
23. Mechanization of processes (Mecaniza)
24. Use of personal data (Usodat)
25. False information (Inforfals)
26. Reading physical books (Lectura)
27. Social isolation (Aislamien)
28. Dependence on technologies (Dependie)
29. Sedentarism (sedenta)
30. Loss of information (Perderinf)
31. Loss of privacy (Perdidap)
32. Absence of physical contact (Ausenfisi)
33. Real-time decision making (Tomareal)
34. Effectiveness, efficiency, and competitiveness (Eficacief)
35. Use of sophisticated technology (Usotecn)
36. Participation in networks (Particip)
37. Agility and precision in searches (Agpb)
38. Use of platforms (Usopl)
39. Sharing links (Comlik)
40. Use of digital laboratories (Usolab)
41. Robotics (Robt)
42. Greater dissemination of knowledge (Madic)
43. Approach to social problems (Acerps)
44. Task automation (Autota)

Figure of Potential Indirect Influences in Pedagogical Practice



Source: Author's own creation in MicMac software.

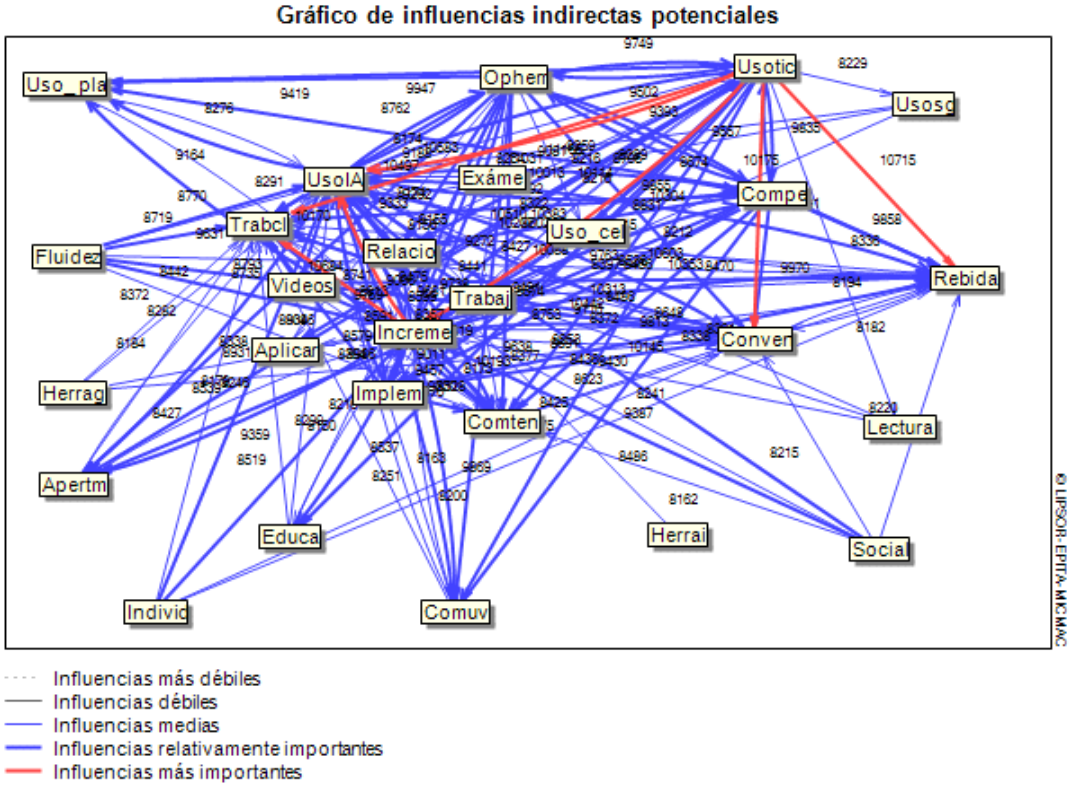
Following the procedures described, the variables detected were placed in the quadrants according to the framework proposed by (Godet, 2007). In Quadrant I, key variables were identified, including the use of digital laboratories, robotics, virtual platforms, AI prompts, task automation, link exchange, solving social problems with technology, real-time decision-making, and social research with key stakeholders. Among the objective variables, characterized by their high dependence, are the dissemination of knowledge through virtuality and the digitization of procedures.

In Quadrant II, determinant variables stand out, such as database management to organize, process, and interpret information for decision-making, a key element in organizational behavior. The regulatory variables include competitiveness in tasks, interaction in digital environments, and research in the classroom. They also encompass access to virtual platforms and the preservation of non-technological spaces to ensure socio-emotional well-being. Among the environmental variables, the capacity for analysis and synthesis to understand the automation of smart buildings and technological ethics is highlighted, promoting the responsible use of technology to solve social problems. These variables have low dependence in terms of communication with the key variables of foresight.

In Quadrant III, autonomous variables can slow down digital transformation. These include reading physical books, procrastination, improper use of personal data, limited language learning, job loss due to complacency, lack of privacy, the spread of false information, social isolation, online meetings, and information loss. However, in the knowledge society, these limitations can be overcome through access to multiple sources of information, unrestricted geographical interaction, and the use of real-time data. Regarding Quadrant IV,

outcome variables are positioned, such as accuracy in information search, high dependence on technology, the absence of physical contact, the use of holograms, and the mechanization of processes. These variables have low motricity and high dependence on other factors. Secondary leverage variables are also identified, where timely information is key to the evolution of the key variables, enabling efficient and contextualized responses.

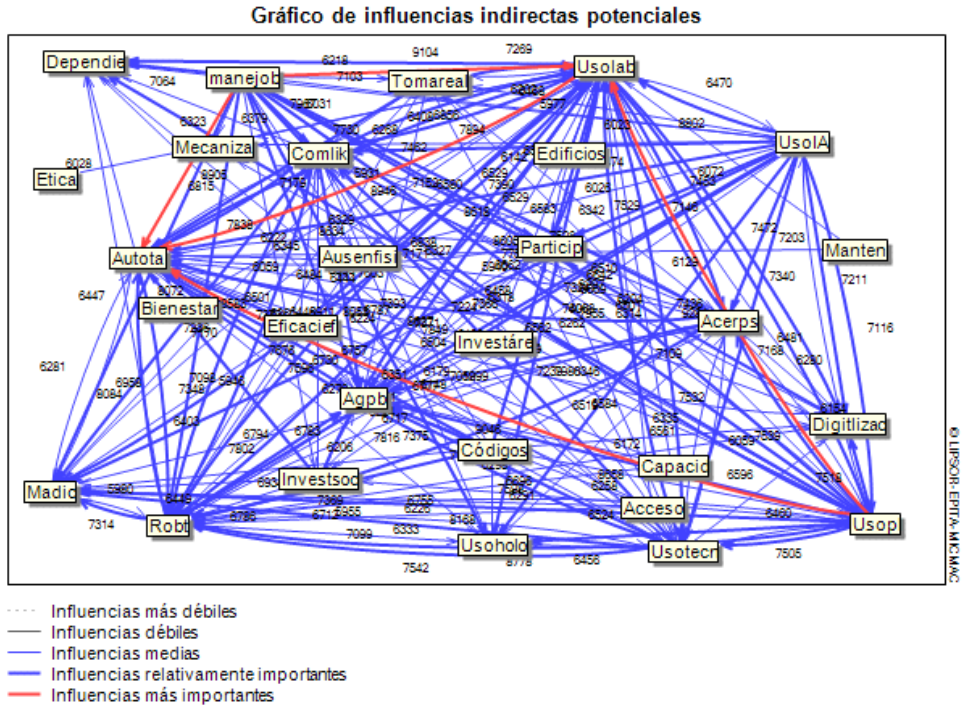
Figure 3. Figure of Potential Indirect Influences of Communication and Collaboration



Source: Author's creation in MicMac software.

The Potential Indirect Influence Matrix (PIIM) graph identifies driving and highly dependent variables in both communication and collaboration within prospective scenarios. One of the influential variables is the use of ICT in academic tasks, whose relationship with Artificial Intelligence (AI) and Big Data facilitates ubiquitous learning and the efficient execution of assignments. According to Carbajal-Amaya, (2020), the prospective environment anticipates an educational transformation through the integration of interactive platforms and immersive communication in virtual reality. This combination will enable new forms of collaboration, exploration, and learning personalization, enriching university education.

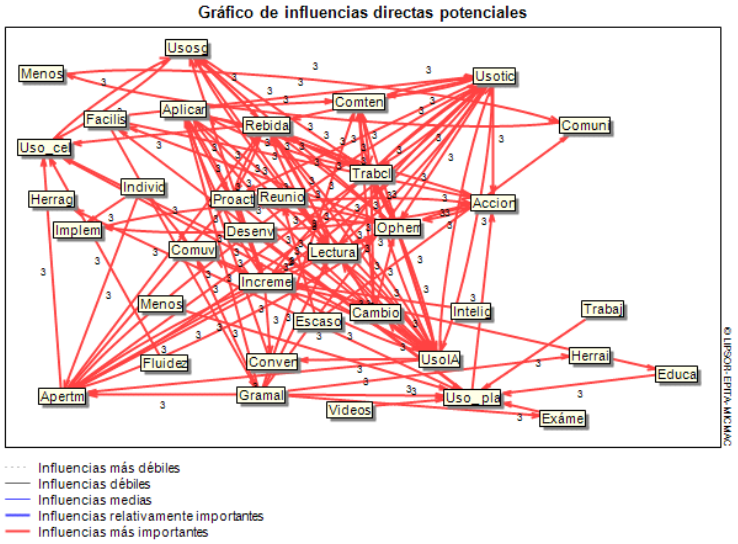
Figure 4. Figure of Potential Indirect Influences of Pedagogical Practice



Source: Author's creation in MicMac software.

The Potential Indirect Influence Matrix (PIIM) graph identifies driving and dependent variables in pedagogical practice within prospective scenarios. The use of platforms and the management of databases influence digital laboratories and task automation, directly impacting teaching. Additionally, variables such as the use of sophisticated technologies, robotics, and knowledge dissemination enhance accuracy in information retrieval. According to Sepúlveda & Perezchica, (2022), robotics will play a key role in the dissemination of knowledge, facilitating innovative and dynamic methods that will transform the teaching-learning process.

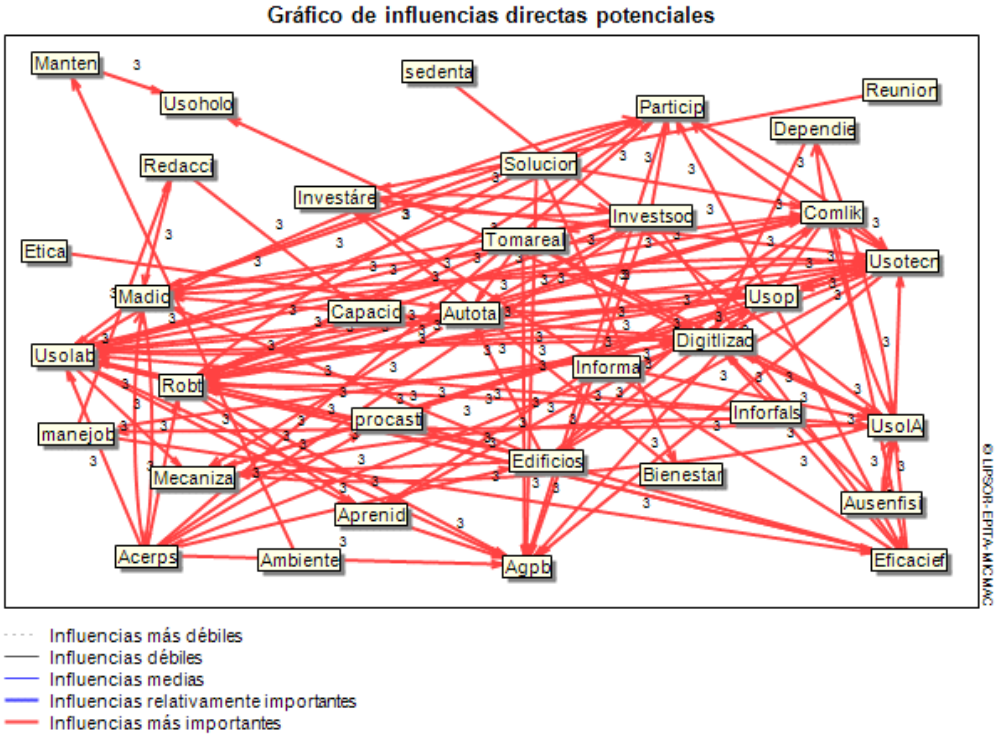
Figure 5. Potential Influence Variables for Communication and Collaboration



Source: Author's creation in MicMac software.

In the graph of variables with the greatest influence on collaborative communication, key factors include the opening of new markets, the use of ICT in academic tasks, and artificial intelligence, including tools such as Grammarly, Chat GPT, and PDF. The integration of ICT in education drives market openness, and the adoption of AI enhances teaching, improving its efficiency, while also preparing students for an increasingly digitalized and competitive work environment.

Figure 6. Potential Influence Variables for Pedagogical Practice.



Source: Author's creation in MicMac software.

The graph of variables with the greatest influence on pedagogical practice highlights interactivity in factors such as participation in networks and the use of advanced technologies. According to Márquez, (2021), interaction in academic networks will be key to fostering collaboration and knowledge exchange. The use of advanced technologies will enrich education through digital laboratories that enhance experimentation and hands-on learning. Furthermore, the integration of robotics will promote the development of technical skills, preparing students for a constantly evolving digital environment.

Figure 7. Pathway Models of the Structural Equation Based on the Estimation of the Free Distribution Syntomic of Collaborative Communication

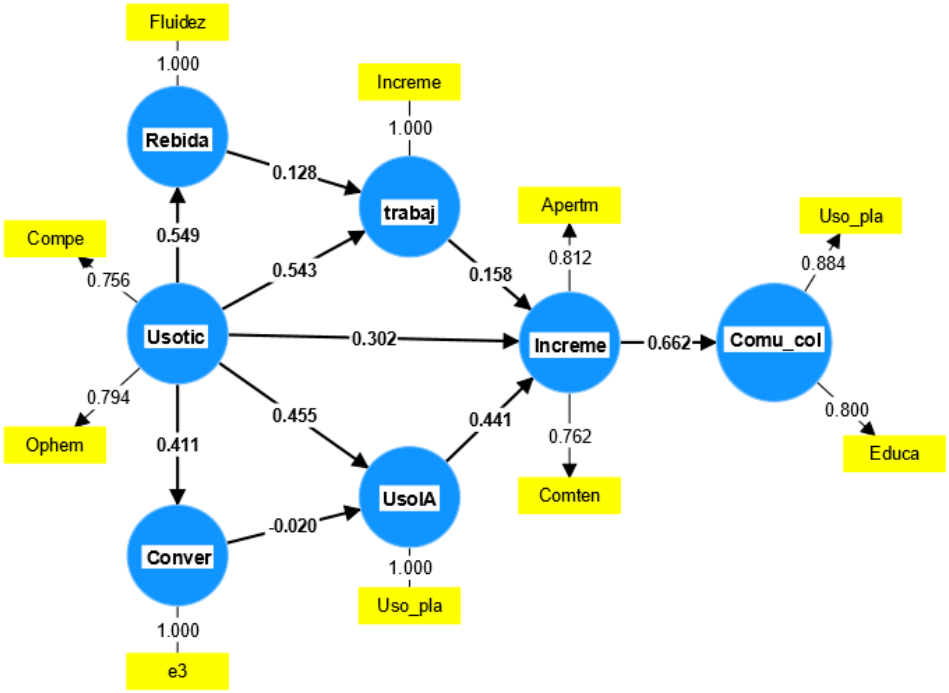


Table 2 Goodness-of-Fit Indices for Communication and Collaboration

	Fit Indices					
	NFI	X^2	CFI	AIC	RMR	SRMR
Parameter	0.90 a 0.95	<5.00	0.95 a 0.97	0.90 a0.95	0.05 a 10	< 0.06
Observed Value	0.91	5.12	0.745	0.901	0.063	0.02

Following the lines described, (Contento, 2019; Reyes-Ramírez et al., 2022) indicate that the Normal Fit Index (NFI) of 0.91 and the Chi-Square of 5.12 validate the adequacy of the model. Meanwhile, (Sánchez-Iglesias et al., 2022) report a Comparative Fit Index (CFI) of 0.745, an Akaike Information Criterion (AIC) of 0.901, and a Root Mean Square Residual (RMR) of 0.041, all within the established limits. Collaborative communication is presented as a latent factor influenced by six variables. The use of ICT in academic tasks impacts: Recurrent Use and Big Data (β=0.549 and $p<0.01$), Work and Ubiquitous Learning (β=0.543 and $p<0.01$), Use of AI (β=0.455 and $p<0.01$), Conventional, Direct and Fraternal Communication (β=0.411 and $p<0.01$), Increased Use of Applications (β=0.302 and $p<0.01$). These values validate the relevance of the model. The integration of ICT enhances learning by enabling the personalization of teaching through Big Data (Márquez, 2021) and promoting ubiquitous learning (Coto-Chotto et al., 2017). Furthermore, AI optimizes educational processes, while the use of technological applications fosters innovation in teaching (Erazo-Castillo & De la A-Muñoz, 2023; Zavala et al., 2017). The graph shows that collaborative communication influences the use of virtual platforms (0.884) and virtual education (0.80). In line with this, (Carbajal-Amaya, 2020; Rivera-Laylle et al., 2017) emphasize that this interaction strengthens the co-construction of knowledge, teamwork, and the development of essential soft skills in the digital environment.

Figure 8. Path models of the structural equation based on the estimation of the asymptotic free distribution of pedagogical practice.

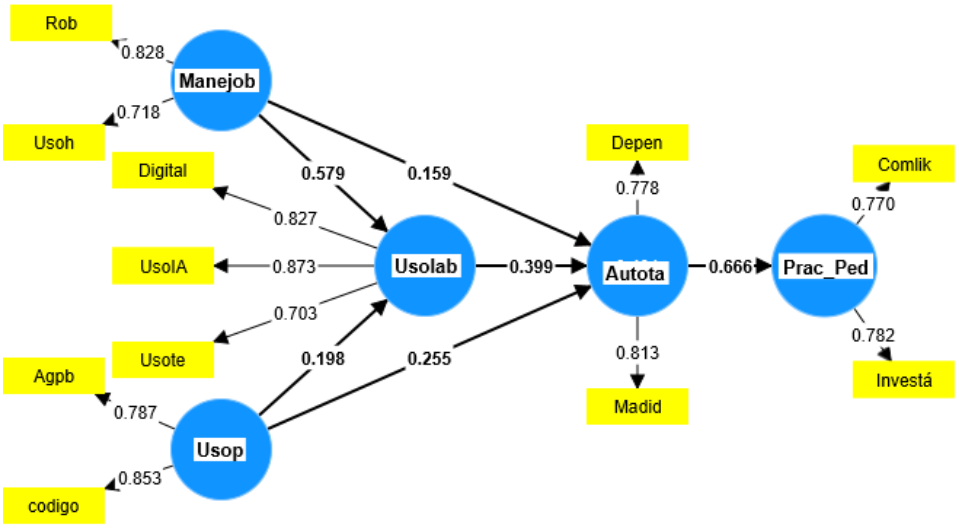


Table 3 Goodness of fit indices of pedagogical practice

	Fit Indices					
	NFI	X^2	CFI	AIC	RMR	SRMR
Parameter	0.90 a 0.95	<5.00	0.95 a 0.97	0.90 a0.95	0.05 a 1.0	< 0.06
Observed Value	0.871	4.10	0.910	0.896	0.071	0.002

On one hand, (Contento, 2019; Reyes-Ramírez et al., 2022) present the indices of the variables pedagogical practice, indicating an NFI of 0.871 and a Chi-Square of 4.10, which demonstrates a good model fit. On the other hand, (Sánchez-Iglesias et al., 2022) report a CFI of 0.910, an AIC of 0.896, and an RMR of 0.002, confirming the relevance of the path model. Pedagogical practice in university institutions is configured as a latent factor influenced by database management, which impacts the use of digital laboratories (β=0.579 and $p<0.01$) and task automation (β=0.159 and $p<0.05$), as well as by the use of digital platforms, which also affect these aspects (β=0.198 and β=0.255, respectively). Therefore, (Parra & Rengifo, 2021) highlight that these variables enhance university teaching by fostering efficiency, interactivity, and the personalization of the pedagogical process. As a result, pedagogical practice has a significant impact on the action of sharing links (0.770) and on research practice (0.782), which, according to (Dirckinck-Holmfeld & Lorentsen, 2003), strengthens the automated exchange of information, promoting a research culture that drives academic and scientific development.

Conclusion

The MicMac method identified two key aspects in the strategic foresight of post-pandemic university students: collaborative communication and pedagogical practice. Collaborative communication is based on the constant use of technological applications and ICT, supported by AI and Big Data for collaborative activities, representing 66.2% of the use of digital tools in communication. Pedagogical practice is characterized by the automation of academic tasks, integrating AI prompts, technological simulators, and access to databases for real-time decision-making. According to the path model, this automation influences 66.6% of the organization of university learning, enhancing the use of laboratories, collaborative platforms, and databases to address social issues.

The prospective analysis and the integration of ICT, artificial intelligence, and Big Data in education play a crucial role in digital and social transformation. These inputs optimize educational processes, promote ubiquitous and personalized learning, and prepare students for a digitalized and competitive work environment. Furthermore, they strengthen collaborative communication, teamwork, and the development of essential soft

skills, which reinforces knowledge and innovation in teaching, achieving a balance between technological innovation, social welfare, and ethics.

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