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ORIGINAL

Impact of the integration of Artificial Intelligence tools in the elaboration of Master's theses

Impacto de la integración de herramientas de Inteligencia Artificial en la elaboración de tesis de Maestría

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ABSTRACT

Introduction: the study presents the development and validation of a model of research skills based on artificial intelligence oriented to facilitate the elaboration of master's theses in the Postgraduate Program of the Public University of El Alto (UPEA).
Method: the research was conducted under a qualitative-quantitative approach at an explanatory level using a quasi-experimental design. The effectiveness of the intervention was evaluated in two phases: one was quantitative, through the application of standardized questionnaires at pre- and post-intervention moments, and the second corresponded to the qualitative, through the Delphi method with a panel of experts.
Results: the quantitative findings demonstrated significant improvements in key areas such as problem formulation, information search and organization, and structuring of the theoretical framework, while the qualitative analysis highlighted the effective integration of methods and the importance of the ethical and responsible use of artificial intelligence.
Conclusions: the combination of both techniques provided a comprehensive perspective of the research process, demonstrating that the incorporation of artificial intelligence tools not only optimizes efficiency and accuracy in thesis writing, but also strengthens students' critical and analytical skills that are necessary to meet the challenges of knowledge generation in the digital era.

Keywords: Artificial Intelligence; Applied Research; Educational Model; Postgraduate Course; Graduate Student.

RESUMEN

Introducción: el estudio presenta el desarrollo y validación de un modelo de habilidades investigativas basado en inteligencia artificial orientado a facilitar la elaboración de tesis de maestría en el Programa de Posgrado de la Universidad Pública de El Alto (UPEA).
Método: la investigación se realizó bajo el enfoque cuali-cuantitativo de nivel explicativo empleando un diseño cuasi-experimental. Se evaluó la efectividad de la intervención en dos fases: una de ellas fue la cuantitativa, a través de la aplicación de cuestionarios estandarizados en momentos pre y post-intervención, y la segunda corresponde a la cualitativa, a través del método Delphi con un panel de expertos.
Resultados: los hallazgos cuantitativos demostraron mejoras significativas en áreas clave como la formulación de problemas, la búsqueda y organización de información y la estructuración del marco teórico, mientras

que el análisis cualitativo destacó la integración efectiva de los métodos y la importancia del uso ético y responsable de la inteligencia artificial.
Conclusiones: la combinación de ambas técnicas permitió tener una perspectiva integral del proceso de investigación, demostrando que la incorporación de herramientas de inteligencia artificial no solo optimiza la eficiencia y precisión en la elaboración de tesis, sino que también fortalece las competencias críticas y analíticas de los estudiantes que son necesarias para afrontar los desafíos de la generación de conocimiento en la era digital.

Palabras clave: Inteligencia Artificial; Investigación Aplicada; Modelo Educacional; Curso Postuniversitario; Estudiante de Posgrado.

INTRODUCTION

For UNESCO[1], "Higher education constitutes a rich cultural and scientific asset that favors personal development and economic, technological and social transformations." Furthermore, it asserts that the mixture of the exchange of knowledge between peers and the teaching staff, the stimulation of research and innovation, together with the will to change a reality that negatively impacts a sector, make up the necessary ingredients for the creation of the required skills that respond to the constant evolution of the labor market.

In recent decades, university education has undergone a significant transformation thanks to the development of Information and Communication Technologies, one of the most apparent changes being virtual learning.

Although distance learning is not a new modality, emergencies make this option preferable to avoid stopping processes at all commercial, informational, and educational levels.[2] It gained significant momentum in the wake of the COVID-19 pandemic, forcing educational institutions around the world to rapidly migrate to online learning modalities. This resulted in the improvisation of scenarios on the one hand and the identification of weaknesses on the other so that each of them could be addressed in the post-pandemic era, exploring expeditious learning alternatives available to all.[3]

Similarly, artificial intelligence has revolutionized various sectors of national and international activity. The university education sector has been no exception because it allows the creation of adaptive learning systems that adapt to the individual demands of learners, facilitating more personalized and effective teaching for them. Advanced algorithms that are useful for analyzing students' progress and learning patterns offering individualized recommendations, and adapting educational content in real time are used. This modality brings with it significant improvements in academic performance and increases students' motivation and commitment to the educational process.[4]

Some studies show that collaborative learning with artificial intelligence tools is capable of transforming education by allowing students and educators to harness the power of technology to achieve greater participation and knowledge sharing, as evidenced by the study carried out by Santiago et al.[5], where they exhaustively analyze the implications of collaborative learning and the ability to understand texts in foreign languages at a higher level, determining that there is a significant relationship between them. From the above, it is evident that collaborative learning is a methodology that strengthens the development of skills and achievements for student teamwork. It can be perfectly applied in various fields of human knowledge and even artificial intelligence.

Likewise, integrating artificial intelligence in the academic field has generated a paradigmatic change in the research process. In particular, using AI-based tools to prepare master's theses not only optimizes the search, analysis, and synthesis of information but also fosters the development of critical and methodological research skills. The proposal presented in this study arises in response to the need identified in the Public University of El Alto Postgraduate Program to strengthen its students' research skills through an intervention incorporating advanced artificial intelligence techniques.

Various studies have also pointed out that artificial intelligence is positioned as a strategic tool that, when applied to research, enhances the ability to delimit and analyze complex phenomena, organize relevant information, and structure critical thinking.

The problem addressed is based on the observation that despite the availability of technological resources, there is a significant gap in graduate students' research skills. This gap is reflected in difficulties delimiting research problems, structuring coherent theoretical frameworks, and applying mixed analysis methods. In line with previous studies, the incorporation of artificial intelligence not only improves efficiency in the search for information but also stimulates critical reflection and analytical capacity, fundamental elements in the training of high-level researchers.

Therefore, the general objective of this study is "To propose a Research Skills Model with artificial intelligence to facilitate the preparation of Master's Theses in the Postgraduate Program of the UPEA." This

model is developed using a mixed methodological approach, with a predominance of quantitative techniques complemented by qualitative methods, and is based on the post-positivist paradigm. The proposal integrates the empirical analysis of competencies through experimental and control groups and validation through the Delphi method, allowing a holistic approach to the research process.

Based on a review of the literature in high-impact databases (PubMed, Google Scholar, PsycINFO, Scopus, and Web of Science) and on the analysis of the document "Research Skills with Artificial Intelligence," this study aims to provide an innovative model that contributes to the substantial improvement of research quality in academic contexts, thus consolidating the training of future researchers capable of facing the challenges of knowledge generation in the digital age.

METHOD

The research is based on a qualitative-quantitative approach, which allowed for the integration of robust statistical analysis following an explanatory sequential design in which the quantitative phase predominates and is complemented by a qualitative study.

Likewise, a quasi-experimental design, characterized by the absence of complete random allocation, allowed for control and comparison between groups. This design was chosen to comparatively evaluate the impact of the artificial intelligence-based intervention on developing research skills to prepare master's theses. Thus, a descriptive, propositional, and explanatory study was proposed to identify improvements in students' research skills after implementing the model.

The sample consisted of 57 participants who were selected using stratified probability sampling, which guaranteed the representativeness of the student population of the Postgraduate Program at the Public University of El Alto. The study participants were divided into two groups:

- Experimental Group (n = 27): Students who received the intervention through the use of artificial intelligence tools, aimed at enhancing their research skills.
- Control Group (n = 30): Students who continued with the thesis writing process in the conventional way, without the contribution of the artificial intelligence-based intervention.

This sampling procedure ensures that variations in research performance are attributed to the intervention rather than to inherent differences in the composition of the groups.

The intervention was evaluated using a range of methods and techniques, integrating quantitative and qualitative strategies:

Standardized Questionnaires (Pre—and Post-Test): Structured instruments were used to measure the students' investigative skills. These questionnaires, based on a hypothetical-deductive approach and analysis-synthesis techniques, made it possible to quantify aspects such as the ability to delimit the problem, organize the information, and structure the theoretical framework.

Structured Observation Guide and Recording by Indicators for the Delphi Method: This method was implemented to complement the quantitative analysis, in which research experts evaluated and validated the research skills model. The structured observation guide allowed for the systematization of observations and ensured consistency in collecting qualitative data.

For the data collection and analysis procedure, the quantitative phase was analyzed using R-RStudio statistical software, which allowed for applying significance tests and comparing results between the experimental and control groups. In the qualitative phase, the Delphi method was implemented through successive rounds of consultation with experts, who provided feedback that allowed for the refinement of the proposed model.

The study was carried out in two differentiated phases for the intervention procedure:

Quantitative phase: It consists of three stages: pre-intervention, intervention and post-intervention.

Pre-intervention: Standardized questionnaires were administered to establish a baseline of research skills in both groups.

Intervention: The experimental group received intensive training in the use of AI tools for thesis writing, which included practical sessions on advanced information search, structuring the theoretical framework and applying analysis techniques using natural language processing algorithms. During this process, elements derived from the document "Research Skills with Artificial Intelligence" were incorporated, which allowed the integration of strategies such as prompt engineering, the use of GPT assistants and quantitative and qualitative software.

Post-intervention: The questionnaire was reapplied to evaluate the changes in research skills.

Qualitative Phase: This consists of validating the Model using the Delphi method, as several rounds of consultation were carried out with a panel of experts in research and in the use of emerging technologies. This process made it possible to identify strengths and weaknesses of the proposed model, as well as to suggest adjustments for its optimization.

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RESULTS

The artificial intelligence-based intervention was evaluated through a comprehensive analysis that combined quantitative and qualitative methods. The findings obtained in each of the phases of the study are presented in detail below.

The results follow the following structure:

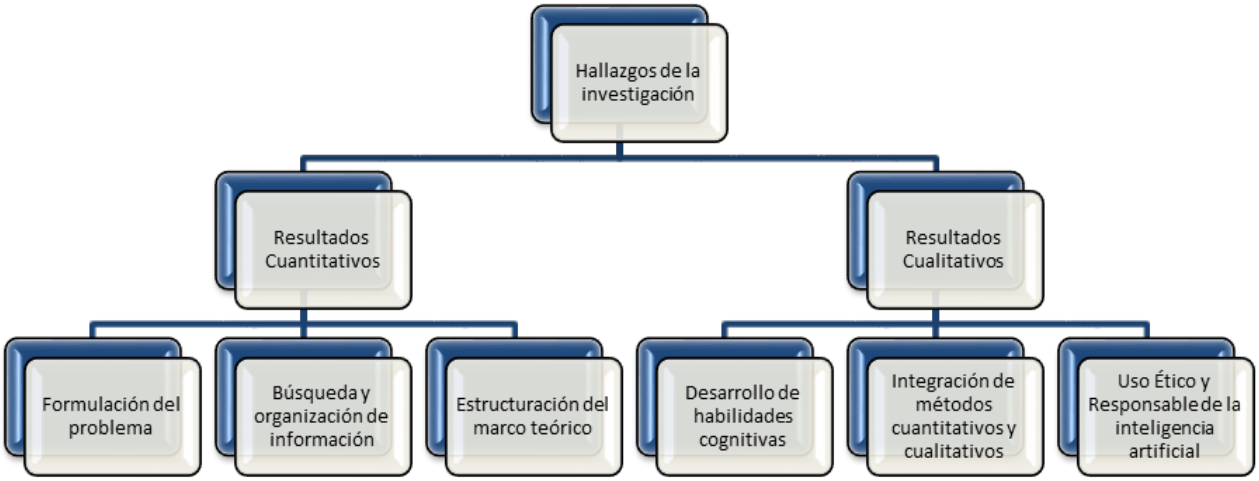

Figure 1. Structure of the results obtained in the study

Quantitative results

During this phase, standardized questionnaires were applied before and after the intervention to measure the investigative skills of the participants. With this test, the assumption seeks the influential measurement of the variable (Research Skills with Artificial Intelligence) and (Postgraduate Thesis) through the total of the sample in the experimental group of 27 elements using the Shapiro Wilk statistic (sample < 50) and Spearman's Rho; against the assumption made, where the value of the correlation coefficient is 0,115, which means an average positive correlation, on the other hand, a significance value (blank result) is not obtained, that is to say less than 0,05; deciding that the study variable does NOT follow a normal distribution.

Given that Artificial Intelligence research skills do influence the Elaboration of a Postgraduate Master's Thesis by 56 % in the sample test, H0 is rejected, and it is concluded that the result is statistically significant.

			PRE	POST
Rho de Spearman	PRE	Coeficiente de correlación	1.000	.115
		Sig. (bilateral)	.	.569
		N	27	27
	POST	Coeficiente de correlación	.115	1.000
		Sig. (bilateral)	.569	.
		N	27	27

Figure 2. Correlation results of the variables Research skills with Artificial Intelligence and Postgraduate Thesis with RHO Sperman Statistics in RStudio

Problem Formulation: The results indicated that the experimental group improved significantly in their ability to delimit and structure the research problem. On average, there was a 56 % increase in the precision and clarity of the formulation, compared to marginal improvements in the control group ($p < 0,01$).

Search and Organization of Information: Efficiency in the location and synthesis of information also showed notable differences. The experimental group showed an approximate increase of 30 % in the management and organization of relevant sources, evidencing a greater efficiency in the integration of quantitative and qualitative data ($p < 0,00$).

Structuring of the Theoretical Framework: A 44 % increase was detected in the quality and coherence of the theoretical framework developed by the experimental group, which suggests that training in the use of artificial intelligence tools strengthened the ability to integrate and analyze complex theoretical concepts.

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Furthermore, correlation analysis showed that the intervention explained around 56 % of the variation in research performance, which reinforces the effectiveness of the implementation of artificial intelligence tools to enhance research skills.[6,7]

Qualitative results

The qualitative component was developed through several rounds of the Delphi method, in which a panel of experts evaluated and provided feedback on the proposed research skills model. This process allowed for the identification and integration of fundamental aspects for the development of the model:

- Development of Cognitive and Analytical Skills: The experts emphasized that the intervention notably improved the students' ability to identify, synthesize and analyze information. It was noted that the application of natural language processing algorithms facilitated a deeper understanding of the research problem.
- Integration of Quantitative and Qualitative Methods: The synergy between quantitative and qualitative approaches was valued, as it allowed for a holistic view of research performance. The integration of both methods enriches the interpretation of the data, allowing for a more precise identification of strengths and areas for improvement.
- Ethical and Responsible Use of Artificial Intelligence: The experts agreed that the intervention promoted a responsible use of artificial intelligence, not only from a technical point of view, but also from an ethical one. This aspect was considered crucial to train researchers committed to transparent and ethical research practices.

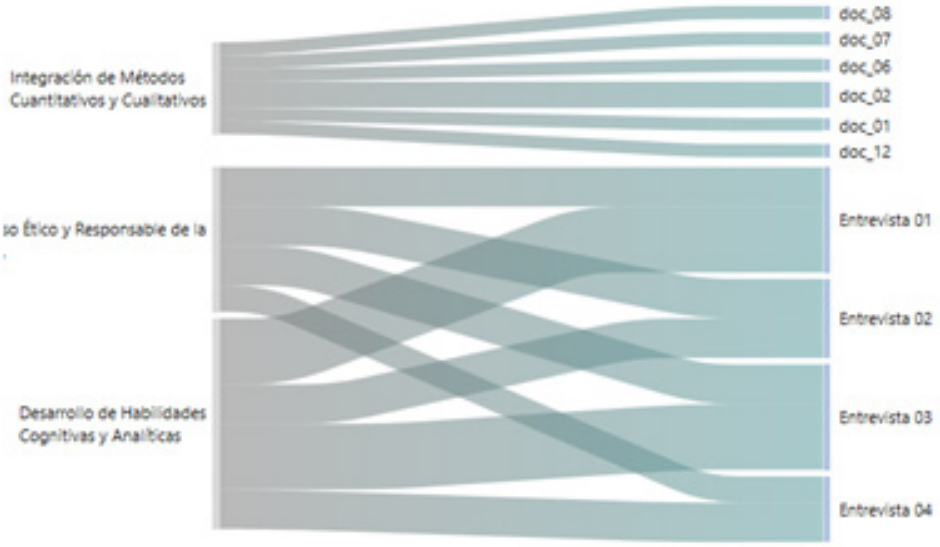

Figure 3. The Sankey Diagram

Figure 3 visually represents the relationship between the sources of information used in the study and the key dimensions analyzed. Its structure reinforces the mixed sequential explanatory approach, in which quantitative methods provided statistical evidence of improving research skills, and qualitative methods validated their effectiveness through the expert perspective.

The figure interprets the integration of quantitative and qualitative methods as the core of the study, supported by documentary sources that consolidate the theoretical framework. This methodological triangulation reinforces the validity of the findings through the combination of complementary approaches.

On the other hand, the ethical and responsible use of artificial intelligence and the development of cognitive and analytical skills were validated mainly through interviews, highlighting the importance of establishing regulatory frameworks for their implementation in academic research.

From an epistemological perspective, the study is framed within the postpositivist paradigm, which allows for the analysis of research skills and the application of artificial intelligence within a verifiable empirical context; qualitative validation was crucial to consolidating the model, emphasizing not only methodological integration but also the need for ethical training in artificial intelligence-assisted research.

The diagram suggests that the implementation of the model should be approached as a comprehensive strategy, where methodological, cognitive, and ethical aspects converge; the correlation identified in the study demonstrates that artificial intelligence-based intervention explains a significant part of the variability in

research performance, indicating that when used in a structured and regulated manner, it optimizes scientific production and strengthens research training in higher education. These findings suggest the need to develop regulatory frameworks and pedagogical strategies that maximize their impact without compromising academic integrity. The replicability of the model in other contexts will make it possible to consolidate an empirical evidence base that reinforces its global applicability.

DISCUSSION

The findings obtained in this study show that incorporating artificial intelligence tools into the process of preparing master's theses has a positive and significant impact on the development of research skills.

Firstly, the quantitative results reveal substantial improvements in critical areas such as problem formulation, information search and organization, and the structuring of the theoretical framework. These findings suggest that the intervention facilitated by artificial intelligence not only optimizes efficiency in information management but also contributes to greater conceptual and methodological clarity, aspects that are essential in academic research. As an example of the efficiency of Artificial Intelligence in research work, there is the study carried out by Bustamante et al.[9], where it was possible to demonstrate that online collaboration tools are fundamental for promoting interaction, the joint construction of knowledge, and deep learning in blended education, and whose findings were known through artificial intelligence in the most critical research processes.

Integrating quantitative and qualitative methods in the design of this study has allowed for a holistic perspective of the research process. The quantitative phase provided numerical data confirming the model's effectiveness, while the qualitative analysis using the Delphi method provided a deeper understanding of experts' experiences and perceptions regarding artificial intelligence's ethical and responsible use. This mixed approach highlights the importance of combining different methodologies to capture measurable results and the more subjective dimensions of the research learning and innovation process.[7]

In this sense, the discussion focuses on three fundamental aspects. On the one hand, there is the optimization of research skills; empirical evidence shows that the experimental group, which used artificial intelligence tools, achieved notable improvements in the delimitation of the problem, the synthesis of information, and the structuring of the theoretical framework. This aligns with previous studies documenting how integrating emerging technologies can enhance critical and analytical skills in the academic environment.

The capacity of artificial intelligence to process large volumes of data and extract relevant patterns translates into valuable support for methodological decision-making, which is reflected in the greater coherence and depth of the research proposals.

Next is the Integration of Methods and Perspectives; the synergy between quantitative and qualitative methods allowed for a multidimensional evaluation of the intervention. While statistical analyses quantified improvements in specific competencies, validation through the Delphi method provided a critical and contextual view of the relevance of the proposed model. This methodological integration reinforces the idea that innovation in research must be approached from multiple fronts to capture both technical effectiveness and conceptual relevance, promoting comprehensive learning that favors the training of researchers capable of facing complex challenges[8] in addition to the fact that the role of the university would be fully fulfilled, as indicated by Rodríguez[10], who states that the role of universities is decisive in terms of training and strengthening formal and informal links to contribute to local and regional development.

Then, there are the ethical implications and future directions; a prominent aspect of the qualitative analysis was the importance of artificial intelligence's moral and responsible use in the research process. The adoption of advanced technologies in the academic sphere implies advantages in terms of efficiency and precision and the need to establish ethical frameworks that guarantee integrity and transparency in knowledge production.

Finally, the results reaffirm that the integration of artificial intelligence in the preparation of master's theses can significantly transform the research process, not only by improving the technical and analytical skills of students but also by fostering a critical and ethical attitude towards the use of emerging technologies, as pointed out by Castro[11], the changes and innovations brought about by globalization and technological development require that the most qualified students be able to perform successfully not only in the professional sphere but also in their civic participation. Therefore, their training must respond to that reality and be applied from various points of view, whether at the micro or macro level, to provide solutions that are hand in hand with technology.

CONCLUSIONS

The present study demonstrates that the integration of artificial intelligence tools in the process of elaboration of master's theses has a significant impact on the strengthening of the research competencies of the UPEA postgraduate students, emphasizing crucial points such as the improvement of their competencies because the application of a research skills model with artificial intelligence facilitated substantial improvement in critical areas, such as the precise formulation of the problem, the search for and organization of information and

the coherent structuring of the theoretical framework. The quantitative results show statistically significant increases compared to the control group, which supports the effectiveness of the intervention.

In addition, there was substantial progress in the integral methodological approach because combining quantitative and qualitative methods allowed for a multidimensional evaluation of the research process. The quantitative phase provided objective data on student performance, while the qualitative analysis using the Delphi method provided a critical and contextual view that enriched the interpretation of the results. This mixed approach is a robust strategy for addressing the complexity of research training.[6]

The findings also indicate that the use of artificial intelligence tools not only optimizes the processes of information analysis and synthesis but also promotes critical thinking and analytical skills, which are essential in the development of robust research proposals. This is in line with previous studies that highlight the transformative role of technology in the academic field.[7]

Finally, the intervention reflected the need to incorporate ethical practices in the use of emerging technologies. The adoption of artificial intelligence in the research process must be accompanied by protocols that ensure transparency, integrity, and responsibility in the generation and management of information. This ethical dimension is essential for training researchers committed to the values of academic research.

In summary, this study provides empirical and conceptual evidence that supports the implementation of a model of research skills with artificial intelligence as an innovative strategy to improve the quality of master's theses, its integration into research training not only in efficiency and precision in data analysis but also strengthening the critical and ethical capacities of future researchers, preparing them to face the challenges of knowledge generation in the digital age.

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CONFLICT OF INTEREST

None.

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