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Experiencias académicas que inciden en la formación en investigación del alumnado de posgrado

Academic experiences that influence the research training of postgraduate students

Experiências acadêmicas que influenciam a formação em pesquisa de estudantes de pós-graduação

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Resumen

El alumnado de los posgrados con orientación científica debe desarrollar la capacidad de aplicar el método científico y los conocimientos teóricos para generar soluciones a problemas actuales. Deben formular alternativas para el desarrollo científico, tecnológico y de innovación que solucionen necesidades en la ingeniería y la tecnología. Por ello, se indagaron las experiencias académicas que inciden en la formación en investigación desde la perspectiva del alumnado de posgrado. La metodología fue cualitativa. Fue una investigación no experimental con diseño transversal. El método fue empírico-analítico con enfoque fenomenológico. Respecto a los hallazgos, se determinó cómo la exigencia académica incide en la configuración del aprendizaje, se identificó cómo el estudiantado desarrolla habilidades y desempeña el proceso investigativo, se precisó cómo el rigor y los elementos metodológicos son componentes formativos. Se concluyó que estos resultados son relevantes para la formación académica y la orientación científica del alumnado de posgrado.

Palabras clave: Enseñanza de las ciencias, formación en investigación, formación de investigadores, investigación científica, método científico, competencias investigativas.

Abstract

Graduate students in science-oriented programs must develop the ability to apply scientific methods and theoretical knowledge to generate solutions to current problems. They must formulate alternatives for scientific, technological, and innovation development that address needs in engineering and technology. Therefore, this study investigated the academic experiences that influence research training from the perspective of graduate students. The methodology was qualitative. It was a non-experimental, cross-sectional study. The method was empirical-analytical with a phenomenological approach. Regarding the findings, the study determined how academic rigor influences the configuration of learning, identified how students develop skills and carry out the research process, and specified how rigor and methodological elements are formative components. It was concluded that these results are relevant to the academic training and scientific orientation of graduate students.

Keywords: Science education, research training, training of researchers, scientific research, scientific method, research skills.

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Resumo

Estudantes de pós-graduação em programas de ciências devem desenvolver a capacidade de aplicar o método científico e o conhecimento teórico para gerar soluções para problemas atuais. Devem formular alternativas para o desenvolvimento científico, tecnológico e de inovação que atendam às necessidades da engenharia e da tecnologia. Portanto, este estudo investigou as experiências acadêmicas que influenciam a formação em pesquisa sob a perspectiva de estudantes de pós-graduação. A metodologia foi qualitativa, tratando-se de um estudo transversal não experimental. O método foi empírico-analítico com abordagem fenomenológica. Os resultados determinaram como o rigor acadêmico influencia a configuração da aprendizagem, como os estudantes desenvolvem habilidades e conduzem o processo de pesquisa, e como o rigor e os elementos metodológicos são componentes formativos. Concluiu-se que esses resultados são relevantes para a formação acadêmica e a orientação científica de estudantes de pós-graduação.

Palavras-chave: Educação científica, formação em pesquisa, formação de pesquisadores, pesquisa científica, método científico, competências em pesquisa.

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Introduction

Students in science-oriented graduate programs must be able to apply the scientific method and theoretical knowledge to generate solutions to current problems. Similarly, their specific skills include: determining alternatives for scientific, technological, and innovation development to meet needs in the fields of engineering and technology. They must also be able to plan and manage research projects, design and conduct experiments, write and disseminate scientific texts verbally or in writing, and strive for social impact (Villegas et al., 2024; Mariscal and Molina, 2025). Therefore, students must have a solid academic and methodological foundation.

In this sense, the teaching and learning processes that take place within academic and research institutions generate, among other substantive functions, the renewal and generational exchange essential for training future generations of researchers who will promote changes to foster a better quality of life (Marín et al., 2023; González-Quiroz, 2024). Consequently, graduate institutions integrate the research process into their students' lives to contribute to the development of their skills and guide their academic and professional

trajectories. However, students entering graduate programs often exhibit deficiencies in various skills; in general, they are subject to gaps in their training (Torres et al., 2022; Peinado, 2025). Therefore, upon completing their graduate studies, they should possess the greatest possible range of skills that will allow them to develop professionally (Cuello and Álvarez, 2024). One example is the ability to write effectively; This is a skill that must be strengthened in graduate students, given that during their graduate studies, they must develop and present academic and research texts, such as essays, posters, their dissertations, research articles, and others (Jiménez, 2021; Baydarova et al., 2023). In this regard, Talaue and Hendijani (2025) posit that conceptions of writing are channeled into the process of articulating and decoding information to share and receive it. Methodological didactics identify writing and reading as a reflective process of meaning-making that serves to rationalize thought.

Furthermore, research training is inherent in the teaching processes of institutions and established researchers in various disciplines, so students depend heavily on these factors during their learning (Romero-García, 2024; González-Quiroz, 2024). Under this premise, postgraduate students depend on adequate support and guidance from faculty to shape the teaching process that provides them with the necessary methodological tools. Regarding this, Paz and Estrada (2022) These resources contribute to the students' development process because, at this stage of their training, they acquire skills that will help them reach their full potential and prepare them for the workplace. Similarly, Marín et al. (2023) point out that methodologically rigorous research is framed as a strategy for obtaining scientific results in an organized and critical manner regarding the reality of a specific problem. In turn, Hirsch and Izarra (2024) emphasize the need for epistemological and methodological supervision in the research process to address ethical considerations that ensure the originality and quality of the inquiry.

On the other hand, it is important to consider the students' projected occupational activity, which may be defined by brief forays into professional work, experience in a specific field, prior experience in their higher education studies, or even continuing a professional tradition within the family context (Clark, 2022; García-Béjar & Galbán-Lozano, 2024). In this regard, students seek experiences that bring them closer to their future careers (Colin & Barajas, 2024). Therefore, it is vital to strengthen the link between research and professional perspectives; thus, it is necessary to enhance their research training so they can transform the social environment. In other words, educational pathways are highly relevant to research, as

they establish the foundation for developing skills for the workplace. Furthermore, entering an occupational dynamic implies profound changes in each person's motivations, possibilities, and circumstances. This directly affects the preparation that the students received and is reflected in whether their transition is easy or more demanding.

Therefore, knowledge about research training for graduate students is still developing; it is a line of research with diverse facets. For this reason, it is relevant to investigate how this training is developed among students. In light of the above, the following research question arises: What academic experiences influence research training from the perspective of graduate students? To answer this question, the central objective was to investigate the academic experiences that influence research training from the perspective of postgraduate students. The methodological foundations of the research are presented below.

Method

The research was conducted using a qualitative methodology (Wieland et al., 2024); a cross-sectional, exploratory, and non-experimental design was employed; and the empirical-analytical method with a phenomenological approach was applied. It was empirical because it was based on the students' experiences and perceptions, as well as their observations of reality. It was analytical because chains of fragments were structured from the students' narratives to establish essential thematic connections. It was phenomenological because it focused on objectively explaining and discerning perceptions of events and their meanings. (McAllister and Lyons, 2022; Peinado and Montoy, 2022). In light of the above, the categories of analysis were academic training, methodological teaching, and achievements.

Participants

The study population consisted of doctoral and master's students from the advanced technology graduate program. The non-probability sample comprised 20 master's students and five doctoral students. Sampling was conducted at the researcher's discretion, based on purposive sampling and its practical application. That is, students were selected based on their availability and their connection to the research topics. Therefore, the representativeness of the sample was not determined by population size, but rather by the experiences associated with the study topic.

Instrument for collecting information

During the data collection phase, semi-structured interviews were conducted using a guide. To ensure reliability, in-depth individual interviews were conducted with two students who were not part of the sample but were part of the population where the research was carried out (Cheung & Tai, 2023). This was the first step in addressing questions and receiving feedback on the study. Furthermore, to guarantee the validity of the research, the judgment of four experts was applied (Dussel & Acevedo, 2024). This allowed for the verification of included aspects and the incorporation of others due to their significance, thus achieving consistency and certainty in the research. The interview guide questions were as follows: 1. In which program are you enrolled? 2. In which semester are you enrolled? 3. Indicate your gender. 4. What is your age? 5. How has the academic demand focused on research been in the postgraduate degree you are studying? 6. What has been the methodological rigor that is applied in the research you are currently carrying out? 7. How have you been provided with methodological elements (procedures, techniques, experimental design, methodology, etc.) to carry out your research? 8. How does the scientific focus of the postgraduate program you are currently pursuing prepare you for the working world? 9. What are the main academic achievements you have attained in the postgraduate program you are currently pursuing? 10. What have been the main methodological achievements you have made in the postgraduate program you are currently pursuing?

Information gathering

The data collection was carried out through interviews with students, who were informed about the privacy of their identity, so no personal data was collected (Olmo-Extremera et al., 2024). Similarly, pseudonyms were used to maintain the confidentiality of their names. This stage was concluded by establishing the criterion of qualitative data saturation (Hennink & Kaiser, 2022; Daher, 2023). This was applied after the interviewees no longer provided new information, and their observations were becoming repetitive.

Systematization and analysis of information

For the systematization of the information, ATLAS.ti version 5 software was used, which is based on the grounded theory of Glaser and Strauss (1967). Grounded theory was based on empirical information examined using the inductive method. It began with an analysis of the environment to provide a coherent argument for the information collected, based on what was observed in a non-standardized manner. The participants' perspectives and approaches were considered in order to reconstruct reality as it was observed (Cheung & Tai, 2023; Valencia et al., 2024). The inquiry was flexible and developed between the facts and their interpretation, and between the responses and their context within the study. All data were compiled in the hermeneutic unit of ATLAS.ti. The narratives generated by the participants were then categorized and coded. The structuring of codes led to the formation of megafamilies, superfamilies, and families. Table 1 shows the classification of megafamilies, superfamilies, and families.

Table 1. Classification of megafamilies, superfamilies and families.

Megafamilies	Superfamilies	Families
1. Academic background	1. Academic rigor	1. Plaintiff
		2. Rigorous
		3. Demanding
		4. Challenging
2. Methodological teaching	2. Methodological rigor	1. Theoretical
		2. Practical
		3. Complex
		4. Strict
		5. Ethical
	1. Methodological elements	1. Experimentation
		2. Knowledge
		3. Procedures
		4. Techniques
		5. Methodologies
	2. Scientific orientation	1. Develop ideas
		2. Gain skills
		3. Apply methodologies
		4. Problem solving
3. Achievements	1. Academic achievements	1. Apply knowledge
		2. Expand skills
		3. Apply skills
		4. Work environments
	2. Methodological achievements	1. Technical skills
		2. Understanding phenomena
		3. Research Impact
		4. Ethical principles
		5. Disseminate research

Source: Own elaboration

This procedure yielded depth, dispersion, interpretive richness, contextualization of the environment, and unique experiences (López & Peinado, 2024; Wieland et al., 2024). Subsequently, these were transformed into results based on a comparison of similarities and discrepancies, to be presented as the foundation for a new conception of information (McAllister & Lyons, 2022). The aim was to advance the application of this methodology's considerations and, at the same time, strengthen the study's focus on understanding postgraduate students' experiences with research training. The main results are presented below.

Results

To characterize certain aspects of the participants, the number of students per program was collected, as well as their distribution by semester, gender, and age. This data is presented in Table 2.

Table 2. Statistical data of the participants

Category	Classification	Mastery	Doctorate	Total
Participants	Student body	20	5	25
Semester	First semester	3	2	5
	Second semester	10	2	12
	Third semester	7	1	8
Gender	Female	4	3	7
	Male	16	2	18
Age	Between 21 and 30 years old	20	3	23
	Between 31 and 40 years old	0	1	1
	Between 41 and 50 years old	0	0	0
	Between 51 and 60 years old	0	1	1

Source: Own elaboration

The figures presented in Table 2 show that the student distribution by program was 20% doctoral and 80% master's. Regarding the distribution of participants by semester, 20% were enrolled in the first semester, 48% in the second semester, and 32% in the third semester. The percentage of students by gender in the study was 28% female and 72% male. Similarly, the age of the enrolled students was divided into three categories: 92% were between 21 and 30 years old, 4% between 31 and 40 years old, and 4% between 51 and 60 years old. It is important to note that the gender of the participants was not variable in the research. Furthermore, it did not influence the research design; it is only mentioned to illustrate the number of participants. It is also worth mentioning that inclusive vocabulary was used in the writing of this manuscript, using generic words to refer to groups that included both women and men.

Regarding the academic rigor focused on research, the students interviewed mentioned that it has been demanding, rigorous, and strict, in accordance with their academic level, allowing them to face different challenges that contribute to their development. Some of their comments were as follows:

> "Without a doubt, it is a high level of demand, corresponding to the level, allowing us to face different challenges that help in our training" (J. Peinado, personal communication, June 24, 2024).
>
> "Very demanding, as it should be. Each challenge pushes me to improve or develop new skills in various areas. It has been a formative experience that presents new opportunities every day to be a better person and professional" (J. Peinado, personal communication, June 24, 2024).
>
> "Well, at first it was very difficult because of the number of subjects in the first semester, but afterwards it became manageable" (J. Peinado, personal communication, June 24, 2024).
>
> "It is a strict requirement but not excessively demanding; it has its degree of difficulty, but it is not impossible to achieve" (J. Peinado, personal communication, June 24, 2024).
>
> "The demands are very high in the intellectual sense, but that commits one to studying more" (J. Peinado, personal communication, June 24, 2024).

Regarding the methodological rigor applied to the research, the interviewees indicated that the theoretical and practical aspects were adequately complemented, that the methodology was very strict to guarantee accurate results, that it is appropriate for the level of study being pursued, and that it provides the knowledge necessary to address the complexity of the topics. Other opinions are presented below.

> "It was precise and detailed. The teaching staff are experts in the development of research projects and are always willing to teach how to structure a research project" (J. Peinado, personal communication, June 24, 2024).
>
> "Each person's profile and ideas are considered to focus the research" (J. Peinado, personal communication, June 24, 2024).
>
> "It has a staggered sequence and in chronological order; initially, it was establishing the problem statement and then how to solve that problem" (J. Peinado, personal communication, June 24, 2024).
>
> "The review with the examiners through the tutorial committees, as well as the scrutiny during the seminar sessions, allowed us to observe the practical elements of the research" (J. Peinado, personal communication, June 24, 2024).
>
> "Very rigorous, because the work has to be supported with progress and the results obtained" (J. Peinado, personal communication, June 24, 2024).

Regarding the methodological elements provided for the research, most students indicated that they obtained them through their thesis advisors, who provided them with detailed instructions on how to conduct the experimental work. They also commented that as they progress, they reach the next stage of experimentation, and when this occurs, the faculty advises them and imparts the knowledge necessary to instruct them on the respective procedures and methodologies to be developed. Other comments included:

> "Through the seminars and subjects provided" (J. Peinado, personal communication, June 24, 2024).
>
> "With the application of experimentation on the research project" (J. Peinado, personal communication, June 24, 2024).
>
> "Through training to use laboratory equipment" (J. Peinado, personal communication, June 24, 2024).
>
> "With the teaching of theoretical and practical elements in class" (J. Peinado, personal communication, June 24, 2024).
>
> "Through the advice of thesis directors and in the tutorial committees" (J. Peinado, personal communication, June 24, 2024).

Regarding the scientific orientation that postgraduate studies provide toward the professional world, those interviewed indicated that it helps them solidify their knowledge, express ideas, solve problems, develop soft skills, and obtain results in their research, among other things. It also provides them with certainty about what they are studying and researching. Further details on this matter are presented below.

> "Everything seen in the postgraduate program is for industrial use, everything applies to the engineering fields" (J. Peinado, personal communication, June 24, 2024).
>
> "Currently, in the workplace, people capable of investigating problems and their solutions are required" (J. Peinado, personal communication, June 24, 2024).
>
> "When visiting a company, they practically use the same test analysis methods that I use in postgraduate studies, which confirms that it is indeed applied in the industry" (J. Peinado, personal communication, June 24, 2024).
>
> "It allows you to see different perspectives on situations that may arise in working life, as well as to learn about tools and develop skills that can be useful in the industry" (J. Peinado, personal communication, June 24, 2024).

> "In an excellent way, since many managerial-level positions require postgraduate studies and this provides the tools and skills for future work in the industry" (J. Peinado, personal communication, June 24, 2024).

Regarding academic achievements, these were classified into three areas: acquisition of new knowledge, development of skills, and professional growth. In this respect, most of the interviewees stated that they had acquired new knowledge related to their field of study, primarily chemistry, welding, materials science, artificial intelligence, and social responsibility, as well as improving their English language skills. Others highlighted the development of skills such as improved analytical ability, self-directed learning, public speaking, and enhanced verbal and written communication. Regarding their professional growth, they specified the following:

> "Progress was made on the research topic" (J. Peinado, personal communication, June 24, 2024).
>
> "An academic mobility to another country was carried out" (J. Peinado, personal communication, June 24, 2024).
>
> "A research stay was carried out in another country" (J. Peinado, personal communication, June 24, 2024).
>
> "The thesis of a bachelor's degree holder was supervised" (J. Peinado, personal communication, June 24, 2024).
>
> "I participated as a synod member for a master's thesis" (J. Peinado, personal communication, June 24, 2024).

Regarding the methodological achievements, the students mentioned that they have acquired the technical skills to operate machinery, tools, instruments, and laboratory equipment. They also reported improvements in information retrieval, a better understanding and explanation of the phenomena they are studying, an increased awareness of the impact of their research, and a grasp of scientific ethics. Furthermore, some students reported publishing a scientific article and participating in conferences. They offered the following observations on these aspects:

> "I participated in different international congresses as a speaker" (J. Peinado, personal communication, June 24, 2024).
>
> "A utility model application was obtained" (J. Peinado, personal communication, June 24, 2024).

"The skill of using laboratory instruments and equipment was developed" (J. Peinado, personal communication, June 24, 2024).

"Techniques were learned to apply in research" (J. Peinado, personal communication, June 24, 2024).

"The ability to write and publish a research article was developed" (J. Peinado, personal communication, June 24, 2024).

The discussion of these results follows.

Discussion of results

Graduate institutions train future researchers, who must meet high standards of quality and originality in scientific research, which is closely linked to the teaching and learning process at the graduate level. The results indicate that academic and scientific activity constitutes a pedagogical and professional development element, which translates into substantial components of student training processes. This finding is consistent with previous research such as that of Soto-Grant and Castro-Garro (2024) and Iwara (2025).

The results also revealed that research training is a cross-cutting component in postgraduate courses that fosters collaborative work between students and faculty, as it generates feedback in both directions. At the same time, ongoing guidance from faculty promotes an understanding of the inquiry process, develops self-regulation, builds discipline, encourages commitment, and fosters perseverance—all fundamental elements in research activity. These results are consistent with those of Baydarova et al. (2023), Rey and Velásquez (2023), and Cuello and Álvarez (2024), which indicate that faculty guidance must be timely, provide sufficient feedback, suggest resources tailored to the needs of the student population, and offer supplementary materials that expand knowledge in the discipline of study, thereby strengthening academic training.

The results showed that the scientific integrity of student research should be reviewed, and its methodology and development monitored, so that deviations can be identified and errors in the design of their work corrected. At the same time, ethical elements should be incorporated into their training process to achieve high standards of quality, integrity, and relevance in knowledge generation. These findings are consistent with those presented by Torres et al. (2022) and by Hirsch and Izarra (2024) in their respective studies.

The findings of this investigation highlight the relevance of students' engagement with the professional field where they will apply their acquired knowledge; this will facilitate their professional development and contribute to improving their quality of life. For this reason, it is important to integrate students into the research process through thesis work or faculty research projects, as this fosters interest, develops skills for generating knowledge, and allows them to participate in solving specific problems. These results are consistent with those presented by Camacho (2022) and Iwara (2025), who emphasize the importance of these formal aspects in research training. In accordance with the above, it is worth highlighting the points made by Mariscal and Molina (2025) and Peinado (2025) regarding social responsibility as a cross-cutting theme in the academic and research training of the student population, which is built with the support of postgraduate research experiences.

The results obtained support students' career aspirations and subsequent professional trajectories, which emerge from the postgraduate environment, the institutional context to which they belong, or from professional practice. In this regard, the findings confirm the importance of exposing students to professional contexts to assure them that their research training will prepare them for the workplace, which is linked to the realities of their disciplines of study, and that they are equipped to handle specific situations in their research work. In line with these approaches, Clark (2022), Colin and Barajas (2024), as well as García-Béjar and Galbán-Lozano (2024). They emphasize that harmony between the academic context and the work environment must prevail to guarantee a symbiotic relationship of continuity and alignment. Following this line of thought, the results contribute to the proposal by Daura and Barni (2024) and Romero-García (2024) that the students' training process and their time in postgraduate studies lead to achievements that allow them to plan their professional careers.

Along these same lines, the results identified that students value writing as a tool for transforming knowledge, helping them develop self-regulation skills. They also expressed a positive outlook on writing, but with the support of their teachers to guide and enhance their abilities in this process. These findings align with those presented by Rey and Velásquez (2023), Talaue and Hendijani (2025), and Villegas et al. (2024) in their respective studies. Based on this premise, we agree with Cuello and Álvarez (2024) and Jiménez (2021) that developing skills in writing theses and research articles fosters the structuring of actions that enhance student learning.

In broad terms, the strengths of this research include its ability to understand how students have developed their learning and perform in the research process. It also explained how academic rigor, focused on research, methodology, and other key elements, contributes to student development. Similarly, the study's findings highlighted that experiences in research training, approached qualitatively and using teaching and learning activities as a reference point, are a way to broaden knowledge of these topics.

On the other hand, the study's limitations lie in the fact that the results found in this inquiry are not necessarily transferable to other contexts; consequently, they are not generalizable. Therefore, it is appropriate to analyze the situation of each context in depth and identify the specific problems of each reality. Similarly, the results are not conclusive, so further research is suggested to clarify how academic research experiences, as narrated by graduate students, contribute to establishing guidelines for their training in the research field.

Conclusions

It is concluded that the proposed objective of investigating research training experiences from the perspective of postgraduate students was achieved. It is also concluded that, through the development of this inquiry, the questions posed at the beginning were answered, the academic demands and methodological rigor focused on research were identified, and the methodological elements provided to postgraduate students were determined.

Furthermore, the study concludes that its results contribute to understanding how students develop their learning, reflect, and perform in the research process. The inquiry also revealed the influence of learning on shaping student development. Finally, it determined how academic rigor focused on research, methodology, and sound research practices contributes to training students in scientific work.

Contributions to future lines of research

This inquiry raises potential avenues for future research. One is that it can serve as a foundation for studies related to emerging technologies, such as the use of artificial intelligence in postgraduate studies and its influence on students (Huang et al., 2025; Zhang et al., 2025). Therefore, it could be analyzed as a complement or a tool to enrich research training at the postgraduate level. Another contribution of this study focuses on the areas of pedagogy and didactics for designing, organizing, and implementing research teaching and instruction strategies at the postgraduate level. In parallel, this research could contribute to broader studies related to updating faculty skills and knowledge that influence research training for postgraduate students.

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