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IS TRAINING NEW RESEARCHERS JUST ABOUT PREPARING THEM IN RESEARCH METHODOLOGY?

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Abstract: There are various dimensions that determine the training of novice researchers through postgraduate programs, ranging from the teaching strategies used by teachers, the relationship established by the teacher, as thesis supervisor-tutor, with their students, to the social and cultural environment reflected in the joint work produced by the teacher and the master's or doctoral student, which is the result of their collaboration. The explanation for this fact must be holistic, since the work of teachers is influenced by different aspects inherent to the teaching process, such as contextual, sociocultural, and personal aspects, in addition to those inherent to the teaching process applied in the teaching of research methodology, its techniques, and the regulations governing the training institution.

Keywords: dimensions in researcher training, training of new researchers, mentoring in researcher training.

The training of new researchers in a Mexican educational institution

Researchers plan their research to investigate the world and explain facts and situations, which, with the advancement of techniques, has led to various revolutions in knowledge and innovation and the pursuit of basic and applied research. If this is geared towards current education and development, it naturally leads to the educational paradigm of the 21st century, in which research plays a decisive role in national progress.

The development of science, technology, and innovation resulting from research into a problem addresses internal, institutional, or labor market interests, or those external to the country, leading to the development of human and intellectual capital. Therefore, for a country to evolve and progress, it requires the participation of researchers, which means that various sectors must invest financial resources and infrastructure to face the almost immediate future represented by the fourth revolution in science and technology.

Nations need teachers and doctors of science who guide their training with a view to becoming researchers. The training of human capital in the field of postgraduate programs generates intellectual capital (Cortés, Olea, and Cuevas, 2019) in all its branches, which stimulates the research training of scientists who, already linked to companies in different sectors, contribute intellectual capital in the form of knowledge, professional skills, experience, and technological development, resulting from the researcher's organizational knowledge of the institution itself and its environment.

This document on researcher training therefore revisits the case of the government educational center corresponding to the National Polytechnic Institute (IPN), which offers programs at the upper secondary, higher, and postgraduate levels, and in which actions that favor their development can be identified. One of the priorities of the Institute's Strategic Transformation Agenda is to carry out "research and innovation with social impact," expanding the culture of entrepreneurship and research in order to innovate and transform the country. It also mentions that "the main objective of Education 4.0 is to train researchers, professionals, and technicians to join the new reality of industry (IPN, 2019, p. 15).

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Level	School year 2024-2025		Total
	Schooled	Not enrolled and mixed	
Upper secondary	72,282	1,166	73,448
Higher	125,079	6,424	131,503
Postgraduate*	6,486	147	6,633
Total	203,847	7,737	211,584

* Includes students enrolled in preparatory courses.

Note: Information obtained from academic units at the upper secondary, higher education, and scientific and technological research levels, IPN. January-December 2024 (cited in the 2024 Annual Activity Report of the IPN General Directorate, p. 43).

Table 1 *Total enrollment at the IPN by educational modality*

According to IPN statistics (2025), Table 1 highlights the current enrollment figures.

It is worth mentioning that 91,88 of these students are women and 119,703 are men.

Returning to the IPN General Directorate's Management Report, January-March 2024, it states that tutorial functions strengthen the academic trajectory of upper secondary, higher education, and postgraduate students. This support is provided "through the guidance that a trained teacher, acting as a tutor, provides to the student with the aim of strengthening their knowledge, skills, and attitudes that lead to meaningful and autonomous learning" (p. 28). There are 55,869 students receiving tutoring at the upper secondary level, 1,698 at the higher education level, and 5,397 at the postgraduate level. The number of academic tutors carrying out this work is 1,802 at the upper secondary level and 13,202 at the higher education level (including postgraduate).

It is important to note that the thesis advisor, who accompanies master's or doctoral students throughout the program, according to the IPN's Graduate Studies Regulations (art. 12), establishes that the academic advisor who was appointed at the time the applicants were admitted, at the end of the first semester of the program, is registered by the students as their thesis director (art. 19) who, according to article 20, will assume all the functions of the advisor. Thus, at the end of the first semester, their thesis director and a tutorial committee or review committee review the progress made by the master's or doctoral student throughout at least three research methodology seminars, which students must pass based on their progress and cannot be credited by revalidation (art. 22). Likewise, and based on Article 90, the tutorial committee is the collegiate body of professors who monitor the development of the thesis, together with the thesis director or tutor who provides ongoing support. These regulations correspond to the normative dimension of the training of novice researchers.

It should be noted that in 1985, the IPN established the Institutional Program for the Training of Researchers (PIFI), whi-

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ch promoted interaction between the research methodology teacher and the student for the purpose of carrying out research activities, favoring the development of skills that lead students to be trained as researchers. Therefore, in order to strengthen students' interest and identification with research work, the Institutional Incentive Scholarship for Researcher Training (BEIFI) was established to encourage students to participate in research projects approved by the IPN's Research and Postgraduate Secretariat. Scholarship recipients participate in research projects and in the productivity that results from them. According to data from the website (https://www.ipn.mx/investigacion/convocatorias-apoyos/estimulos/pifi.html), in the semester from January to June 2025, 219 BEIFI scholarships were awarded at the upper secondary level, 1,707 at the higher/postgraduate level, and 774 at research centers.

Currently, there is talk that students require research training based on projects developed in postgraduate curricula that prioritize the training of researchers.

But how are these novice researchers trained?

From an institutional perspective, starting at the upper secondary level, the IPN begins to train its students in research. In addition to supporting the research carried out by teachers, it has also implemented the Classroom Project, sponsored by the IPN's Department of Educational Projects and Upper Secondary Student Equivalencies (NMS), which, according to its website "strengthens the teaching-learning process through methodological work... an approach enriched with technologies" (https://

www.ipn.mx/assets/files/cecyt11/docs/proyectoaula/plandetrabajo.pdf). This work contributes to the comprehensive training of students as it encourages research and collaborative work, stimulating creativity, which has an impact on the students' trajectory as it favors the development of new skills and knowledge.

At the higher level, students can be trained through the curriculum and participate in research projects led by undergraduate or graduate faculty. However, for training to exist that considers image, motivation, collaborative work, and real belonging, students must feel that they have achieved their personal goals that allowed them to graduate. Similarly, their thesis advisors (tutors) should perceive that, as a result of teamwork (interaction), they have made theoretical contributions and/or solved problems with originality or knowledge creation, and those responsible for institutional programs should perceive that, through their learning units, they have succeeded in training new researchers.

Researchers teach methodological content based on models they consider appropriate and apply almost mechanically in their studies, but this does not always encourage novice researchers to reflect and question the reasons behind the phenomenon being studied. It is therefore difficult to ensure that the contributions they make at the end of their research, which they use to compile their thesis, will tend to create new knowledge. To truly enter the process of becoming researchers, it is advisable for students to participate and team up with the researcher. By working collaboratively and harmoniously, they would be able to produce their thesis from the research work in which they participate. Master's and doc-

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toral students learn methodology and techniques from a qualitative and quantitative approach, from an epistemological point of view that allows them to understand the basics of the research process.

Table 2 presents the elements that influence the research training of IPN students.

According to the data in Table 2, it can be seen that there are sociocultural and personal aspects that influence research training. It is important that the development of research skills in master's and doctoral students begins with a solid technical/technological background in the area of study, as well as a cultural background that favors the exercise of personal qualities such as creativity, openness to innovation, critical thinking, and ease of collaborative work, framed within the stages of logical thinking, such as analysis and synthesis, which are present during their training. However, this task of teaching research is influenced by various components, such as social factors that explain the behavior of thesis supervisors and students who identify and adjust their behavior by taking the researcher as a model; those of the educational institution itself, with its regulations and curricula, in whose programs pedagogical models and psychological factors are fundamentally immersed, according to the psychodynamic process experienced in their maturation, and which have fostered, or not, the development of resilience, leadership, self-esteem, and assertiveness, mainly. In these aspects, the process of family socialization also intervenes, which can provide security and equality, or vice versa, for the development of researchers based on gender and what has been introjected regarding the role they can play in creating science (López, 2015). Hence, it can be said that

teaching research is a process that requires academic discipline and imagination, since information is sought, analyzed, compared with what is needed, tested in the field of interest, reanalyzed to arrive at a synthesis, all of which represents a permanent process of doing and redoing, since it leads to adjustments to what was initially conceived and requires writing and rewriting until satisfied, according to the research design and the part of reality from which it started. It is constructed, there is a break, and it is reconstructed. Research training should encourage epistemological reflection and put what is learned into practice.

Therefore, students who are training as researchers must be "adopted" by the researcher who guides and trains them and, through the process of socialization and modeling, learn attitudes, values, and commitment, and even share the conception of reality. Here, the worldview is present in both the explicit and hidden curricula, which has an impact on the cognitive, affective, and motivational aspects that arise in the interactions between the thesis advisor/tutor and the master's and doctoral students, although this situation is not always recognized in areas of the exact sciences , which consider it to be something subjective, outside of a conception that leads to the development of science and technology.

In the research process, both the tutor and the novice researcher should select each other based on their discipline and interests, since working together in a stimulating environment has an impact on productivity, collaboration, and mutual benefit, which even translates into the amount of scholarships and, in the case of the researcher, recognition from bodies such as the National System of Researchers (SNI) and their

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Some factors involved in training	Thesis supervisor/research tutor with experience	Graduate students New researcher
Interactions	X	X
Motivations	X	X
Relationship with peers	X	X
Adaptation to similar groups	X	X
There is reflection, analysis, synthesis	X	X
Influences interest and willingness	X	X
Personal self-assessment	X	X
Learn about discipline	X	X
Learning by modeling		X
Formed through mediation		X
Learns theoretical content		X
Learn to do science based on methodological content (know that)		X
Learn methodological techniques, practical knowledge (know how)		X
Internalize norms and values (know why)		X

Table 2 Main elements involved in research training

Note: own elaboration.

performance scholarship as a researcher. The tutorial relationship is entirely formal, as mentioned above, and is based on the Postgraduate Study Regulations.

On another note, it should be pointed out that these novice researchers need to have the ability (or develop it, with the support of their tutors, who are usually experienced researchers) to convey the results of their work in writing through communications that can be presented at various academic events. According to González and Román (2016), educational institutions rarely prepare novice researchers to disseminate the findings of research projects carried out to obtain master's or doctoral degrees.

Contextual aspects that influence the training of researchers

Ortiz (2010) states that in developed countries there is a link between the government, the private sector (companies), non-governmental organizations, and higher education institutions, which provide financial resources to meet the needs of educational institutions in training future researchers.

Therefore, in the case of Mexico, it could be said that if the Quinta Hélice systemic methodology were applied and its components were addressed in terms of research, this would have an impact on the country's

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economic development and th , which would facilitate the integration of research, development, and innovation. According to Martínez, these refer to:

• Government agencies with their national and international educational policies, an example of which is the National Council for Humanities, Sciences, and Technology (CONAHCyT), which is a decentralized body that promotes research and the development of innovation and technology.

• economic sectors and their needs,

• companies,

• professional associations/colleges (consultants), and

• universities.

These five components should be linked for professional training in research (Martínez, 2012).

This section also considers the regulations governing the training of researchers, ranging from the Political Constitution of the United Mexican States and the General Education Law to the IPN's own regulations, such as the Organic Law, the Postgraduate Studies Regulations, and institutional planning programs, which establish the need to strengthen the link between institutional research and the requirements of the public, private, and social sectors.

Aspects of thesis supervisors/tutors that influence the link established with master's and doctoral students

• Some researchers find it difficult to balance teaching and research, as depending on their type of appointment, they have to fulfill certain hours in front of a group, which can prevent them from dedicating more time to learners and linking them to their research project, sparking their interest and promoting productivity on both sides.

• Class schedules are set without analyzing the individual situations of students in training, which means that a student in training may be assigned to a research internship with another research professor. If a change is desired, it is not administratively possible, because usually when master's or doctoral students enroll, the official registration period for courses and the research professors who will teach them has already closed.

• In some cases, a thesis advisor/tutor is assigned to a student who is not interested in the research project or in establishing close interaction in a harmonious academic environment and only wants to write a thesis as an administrative process that will facilitate the obtaining of their degree.

• Students in training who are unmotivated to contribute or solve theoretical or technological problems.

• When, as a result of the socialization process experienced by both teachers and students, interaction is impacted by a problem of non-acceptance of the gender of the other party with whom research is to be conducted through collaborative work. This

situation has an impact on motivation, leadership, resilience, creativity, and even cognitive aspects.

• Another influencing factor is that some researchers do not have enough time to train their students, and this is exacerbated when there is no appropriate environment or identification between both parties. A researcher may be more interested in producing publications and graduating more students (without concern for whether or not they are trained as novice researchers) in order to maintain their membership in the SNI and receive their Researcher Performance Incentives (EDI grant), which recognizes researchers and translates into financial rewards and higher academic and social status.

• Similarly, the participation of the tutorial committees, which are made up of five teacher-researchers, including the thesis supervisor, is very important. At the end of each semester, these committees review the student's progress in the research they are conducting for their thesis. ly, this situation may reflect the lack of time allocated to reading the master's or doctoral student's thesis; some researchers participate and present themselves as part of the committee without having analyzed the document. It may even happen that, based on their training and experience, they favor methodological aspects and techniques different from those presented by the student and recommend that they be applied without any basis, since they do not clearly understand the work that has been done.

• Although it is considered that research is learned by doing, there is no guarantee that the teacher-researcher has the appropriate teaching strategies to gradually train the young researcher as the research

and thesis progress, activating the emergence of knowledge that the student may consider relevant to the subject of study. Nor does it guarantee that they will be able to guide them in writing papers and articles or even encourage joint participation in national and international academic events.

Models and competencies to consider in the training of researchers

According to Rivas (2011) and Pérez, Topete, and Rodríguez (2014), there are various models that consider the competencies necessary to develop or strengthen in researchers.

There are case studies on research skills in various contexts, such as those by Kiley, Moyes & Clayton, 2009, Koppi, Nolan & Field, 2010, Valter-Akerlind, 2010, Henderson, Nuñez & Casari, 2011. Studies on "strategies for the development of research skills in specific cases and fields of knowledge" by Helm, McBride, La Bianca, 2011, Kiley, Moyes & Clayton, 2009, and Murdoch, Dewey, Elton, Emmerson, Marshall, Smith, Stark & Whittle, 2010. (Rivas, 2011: 35-36).

Models focused solely on the research process

Partingon (2002) considers that skills in philosophy and epistemology are necessary, as are those related to the research process and the techniques on which it is based.

Evans (2011) states that research training is influenced by behavioral development (changes in process and procedure, productivity, and competitiveness, but with

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reference to improving research capacity). Attitudes related to perceptual, evaluative, and motivational changes with respect to research are displayed. There is also intellectual development related to epistemological change in the field of reasoning, in terms of understanding and analysis with respect to research.

Models that address personal aspects and those related to research

Berkeley (2004). Establishes 21 aspects, which can be grouped into seven competencies: three of them are related to research methodology and refer to: Specialized knowledge (your discipline and related areas); philosophical aspects of epistemology; and methodological skills (information search; research design and knowledge of quantitative and qualitative methods; recognition of good and bad research). The four competencies related to social skills and personal traits correspond to: Communication skills (writing, creating logical arguments, oral expression), general knowledge (computational, planning, and time management); skills for working with others (supervisor, colleagues, and research subjects; for creating networks and contacts). Personal traits (creativity and innovation, emotional intelligence; perseverance and ability to maintain a high pace; ability to improvise and overcome limitations).

Models for learning scientific research in research groups

Laursen 2010 and Lopatto, 2004 focused on the research experience of undergraduate students. They investigated the liberal arts, although only a small group was considered capable of thinking creatively about research design.

Feldman, Divoll & Rogan, 2009. Teachers must recognize that their students are learners and that they can develop their methodological mastery by being proactive in helping their undergraduate, master's, or doctoral students develop intellectual skills. It is necessary to recognize the role of peer mentoring (in the research laboratory) in improving relationships within the research team.

Nersessian et al. (2005, 2008) conducted interdisciplinary research in science laboratories, understanding this to mean both the physical space and that of an organized social group. Their approach is cognitive-cultural. Vitae, together with the UK education sector (2010), developed a register that allowed for the planning, promotion, and support of the personal and professional development of researchers' careers.

Mexican models for training researchers

Rivas (2011) discusses models that establish the necessary competencies that a researcher must have. However, he does not consider personality traits, as these can vary depending on the field (engineering, mathematics and computing, medical-biological, social-administrative, humanities, or arts). In addition, there are other traits

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that are inherent to human nature and are not limited to researchers. This author establishes the LART model, which consists of nine skills:

- Problem formulation,

- developing the contextual framework,

- review the state of the art,

- create and validate models and instruments for collecting information,

- know how to present a paper at a scientific conference,

- have knowledge of quantitative and qualitative analysis techniques,

- know how to structure and write a scientific paper,

- have a command of languages, and

- knowledge of universal art and culture.

For Ortiz (2010), the training of researchers is influenced by factors specific to the individual and contextual factors such as cultural, social, political, and economic aspects, in addition to those specific to educational institutions.

Moreno (2011) proposes the development of seven skills in the training of researchers:

- Perceptual skills,

- instrumental skills specific to the command of an official language,

- Thinking skills ranging from critical to flexible thinking,

- conceptual knowledge that is appropriated and reconstructed, with the possibility of applying analysis and synthesis,

- methodological skills,

- skills for the social construction of knowledge,

- metacognitive skills.

Pérez, Topete, and Rodríguez (2014) revisit the dimensions considered by Evans and Moreno, linked to behavioral development, intellectual/epistemic development, and attitudes, and add a fourth dimension that they consider indispensable ( ): the development of social responsibility, which represents commitment and whose components are:

- Proficiency in other languages (facilitates diverse learning, making it more competitive),

- Ability to work in a team (promotes budget management and creates an academic culture with a social focus or as part of research networks, even at the international level),

- ability to carry out work oriented towards the productive, social, and governmental sectors of the country that have an impact on the country's economic development.

Final considerations by way of conclusion

In conclusion, it is ideal for master's or doctoral students to participate in research projects in which the thesis director/research supervisor selects the subject of study, quality, and type of research and requests resources (financial and/or infrastructure), and from which the student learns by conducting research collaboratively, sharing, and contributing, since if the relationship is appropriate, their potential will be developed and their creativity fostered, with motivation as an important factor. González and González (2015) conclude, as a result of re-

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search in a master's degree in Industrial and Business Administration in Nuevo León, that the research process is determined by self-motivation and by the realization of an idea that translates into a service or product.

There is still much to be done in postgraduate programs, but the most important thing is to be aware that when novice or experienced researchers apply and teach research methodology and techniques, they are affected by personal (psychological), social, and cognitive (epistemological) dimensions, as well as those specific to the discipline in which they work, and by the constant shift between construction, disruption, and reconstruction that transforms information in the dynamic process. All of this is influenced by the national and international context.

When conducting research at the IPN and any other educational institution, research linked to the context promotes Mexico's development because it addresses needs, innovates, and drives technological development. We must move from a quadruple helix economic development model to the Fifth Helix systemic model, where there is a link between economic sectors and their needs, government policies, companies, groups of recognized specialists in associations and colleges, and educational institutions that train and conduct research.

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