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*Scientific articles*

## **Propuesta para determinar un modelo pedagógico sobre competencias investigativas a nivel doctorado**

***Proposal to determine a pedagogical model on research competencies at  
the doctoral level***

***Proposta de determinação de um modelo pedagógico sobre competências  
de investigação a nível de doutoramento***

**Márquez-Silva, Fátima**

Universidad Autónoma de Querétaro, México

[fmarquez11@alumnos.uaq.mx](mailto:fmarquez11@alumnos.uaq.mx)

<https://orcid.org/0009-0005-3612-3541>

**López-Martínez, Rocío-Edith**

Universidad Autónoma de Querétaro, México

[rocio.edith.lopez@uaq.mx](mailto:rocio.edith.lopez@uaq.mx)

<https://orcid.org/0000-0002-5209-3523>

### **Resumen**

Los procesos de formación están definidos por las competencias que busca desarrollar en sus aprendices; para el desarrollo de investigaciones en cualquier campo disciplinar, se fomenta la adquisición de diversas herramientas, capacidades, conocimientos y actitudes. El presente documento tiene por objetivo analizar los procesos formativos que potencian las competencias investigativas, con la identificación de necesidades educativas en contextos específicos, que permitan la definición de un nuevo modelo pedagógico para reducir las brechas entre el campo de la docencia e investigación. Se realizó una cartografía conceptual con la intención de encontrar referentes teóricos y metodológicos.

Los resultados obtenidos se organizaron en ocho ejes analíticos, la noción permitió explorar las definiciones; la categorización ofreció diferentes dominios sobre cómo se construyen estas competencias; esta última demostró algunas experiencias de enseñanza y aprendizaje. En diferenciación se describen tres constructos, en clasificación se ubicaron los tipos de



conocimientos, habilidades y actitudes. Para vinculación se asociaron los casos en los que las competencias investigativas se han implementado con diferentes referentes de *e-learning*. Al final, en metodología se mostró cómo el modelo *microlearning* se constituye y cómo se pueden conformar micro contenidos. Por su parte, en ejemplificación no se encontró ningún estudio que ya haya relacionado las variables. Se concluyó que, un modelo pedagógico para competencias investigativas se caracterizaría por estar enfocado en la internalización de saberes, aprendizaje autónomo, el desarrollo de autogestión y auto motivación sobre procesos indagatorios en diversas áreas del conocimiento.

**Palabras clave:** competencias investigativas, enseñanza de la investigación, habilidades investigativas, micro aprendizaje, proceso de investigación.

### Abstract

The training processes are defined by the competencies they seek to develop in their learner; for the development of research in any disciplinary field, the acquisition of diverse tools, skills, knowledge, and attitudes. This document aims to analyze the training processes that enhance research competencies, identifying educational needs in specific contexts, allowing the definition of a new pedagogical model to reduce the gap between teaching and research. A conceptual cartography was developed with the intention of finding theoretical and methodological.

The results were organized into eight analytical axes; the notion allowed exploring the definition; categorization offered different domains on how these competencies are constructed. Characterization demonstrated some teaching and learning experiences. Differentiation described three constructs, and in classification, the type of knowledge, skills, and attitudes was described. For linkage, cases where research competencies have been implemented with different e-learning references, finally, in methodology, it was shown how the microlearning model is constituted and how microcontents can be formed; meanwhile, in exemplification, no study was found that had already related the variables. It was concluded that a pedagogical model for research competencies would be characterized by being focused on the internalization of knowledge, autonomous learning, the development of self-management, and self-motivation on investigative processes in various areas of knowledge.

**Keywords:** research competencies, research teaching, research skills, microlearning, research process.

## Resumo

Os processos formativos são definidos pelas competências que procura desenvolver nos seus aprendizes; Para o desenvolvimento da investigação em qualquer área disciplinar, incentiva-se a aquisição de diversas ferramentas, competências, conhecimentos e atitudes. O objetivo deste documento é analisar os processos de formação que potenciam competências de investigação, com a identificação de necessidades educativas em contextos específicos, que permitam a definição de um novo modelo pedagógico para reduzir as lacunas entre o campo do ensino e da investigação. Foi realizada uma cartografia conceitual com o intuito de encontrar referências teóricas e metodológicas.

Os resultados obtidos foram organizados em oito eixos analíticos, a noção permitiu explorar as definições; a categorização ofereceu diferentes domínios sobre como essas competências são construídas; estes últimos demonstraram algumas experiências de ensino e aprendizagem. Na diferenciação são descritos três construtos, na classificação foram localizados os tipos de conhecimentos, habilidades e atitudes. Para vinculação, foram associados os casos em que as competências de pesquisa foram implementadas com diferentes referências de e-learning. Ao final, a metodologia mostrou como se constitui o modelo de microaprendizagem e como o microconteúdo pode ser formado. Por sua vez, a título de exemplificação, não foi encontrado nenhum estudo que já relacionasse as variáveis. Concluiu-se que um modelo pedagógico de competências investigativas se caracterizaria por estar focado na internalização do conhecimento, na aprendizagem autônoma, no desenvolvimento da autogestão e da automotivação nos processos investigativos nas diversas áreas do conhecimento.

**Palavras-chave:** competências de pesquisa, ensino de pesquisa, habilidades de pesquisa, microaprendizagem, processo de pesquisa.

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## Introduction

The research process applied in various fields of study and educational levels allows the acquisition of a specific type of capabilities, these are the investigative competencies. The cognitive constructs that allow understanding theoretical references, application of tools and manipulation of research techniques or strategies, useful for the search for solutions, as well as the realization of projects with an ethical sense and the development of some attitudes for inquiry, such as intellectual honesty, care against plagiarism and academic integrity.

The purpose of this research is to address investigative competencies, the analysis of their definition, development and application in the educational field. Without being characteristic of a single discipline, but as a representation of mental, procedural and attitudinal skills for the benefit of successful and applied research projects in various disciplinary areas. Therefore, a conceptual cartography (CC) was developed as a research strategy, with the objective of analyzing the theoretical and methodological foundations to generate a proposal as a model of investigative competencies and *microlearning*.

Considering that *microlearning* is a digital education methodology for building skills in a brief manner and focused on specific objectives, to improve the retention and use of knowledge, presented in small units, which facilitate learning (Nurul and Rafiza, 2023); it is transcendental in digital and mobile environments where users can access content flexibly and at their own pace (Machado *et al.*, 2024).

Conceptual cartography, as a qualitative documentary research technique, allows the location of specialized nodes of terms and categories that intervene within research projects (Tobón *et al.*, 2015). Its main characteristics are: visualization, because it graphically represents its concepts and interactions; hierarchization, due to the organization of its concepts from the general to the specific. On the other hand, interconnection shows the relationship between its various concepts; finally, the facilitation of learning improves the understanding and retention of information (Herrera and Tobón, 2017).

Therefore, the state of knowledge on the possible conceptual interaction between the competencies of the research process and micro learning is unknown, which is why it was decided to carry out a CC. The result of the investigation is appreciated along eight axes of analysis proposed by Tobón *et al.* (2018), with the purpose of identifying a series of educational needs that allow the definition of a new pedagogical model.

## Materials and methods

A documentary research was carried out using the conceptual mapping (CM) technique proposed by Tobón (2017, p. 34), known as a complex thinking assessment tool for the administration of socio-formative projects. CM allows the researcher to carry out a search process for specialized information through various databases, inclusion criteria are defined to select the sources, as well as the construction of analysis categories, based on eight axes (Tobón *et al.*, 2018, p. 4; Tobón *et al.*, 2015).

For this reason, a search was carried out in two databases using the formula (*Research skills OR Research competency model*) AND (*Microlearning NOT Elearning*), applied to *ERIC* and *EBSCO*. These platforms were chosen because they obtained results that considered some of the keywords, since, in other platforms, the list of selected variables showed an error or indicated that there were no results, giving a total of 308 articles.

### Document selection criteria

According to the relationship of variables, the criteria for selecting documents focused on integrating scientific publications or research articles. All those titles that state any of the keywords and that were found with the application of filters:

- Published between 2019 and 2024.
- *article research* filter was activated in EBSCO; for ERIC, *Publication type-Reports research* was selected .
- Belonging to the area of Social Sciences. With the help of the *Subject filter on the EBSCO platform*. For its part, in ERIC, the *Descriptor-Research Skills* filter was applied .

### Study Categories

The conceptual mapping strategy was developed through eight axes of analysis, in which eight research questions were linked, accompanied by categories. With these, we sought to build a guide that allows the organization of the acquired knowledge (Table 1).

**Table 1.** Systematization of results.

No.	Axis of analysis	Research Questions	Categories	Authors
1	Notion	What is the concept of research competence?	1.1 Foundation of research capabilities.	<ul style="list-style-type: none"> <li>• Cabrera Félix <i>et al.</i>, (2023).</li> <li>• Mendioroz-Lacabra <i>et al.</i>, (2022).</li> <li>• Peace and Estrada (2022).</li> </ul>
2	Categorization	How are research competencies ranked in educational models?	2.1 Development of research skills in different domains or categories.	<ul style="list-style-type: none"> <li>• Esteban and Ostrovsky (2020).</li> <li>• Fúster-Guillén <i>et al.</i>, (2022).</li> <li>• Huddleston <i>et al.</i>, (2020).</li> <li>• Long <i>et al.</i>, (2020).</li> <li>• Marble <i>et al.</i>, (2022).</li> <li>• Poblete-Valderrama <i>et al.</i>, (2023).</li> <li>• Quincho <i>et al.</i>, (2023).</li> </ul>
3	Characterization	What are the characteristics of the research skills development process?	3.1 Teaching and learning process for research competencies.	<ul style="list-style-type: none"> <li>• Abdulrahman and Rutatola (2021).</li> <li>• Cabrera Félix <i>et al.</i>, (2023).</li> <li>• Fuster-Guillén <i>et al.</i>, (2022).</li> <li>• Sanchez and Rodriguez (2023).</li> </ul>
4	Differentiation	What is the conceptual difference between skill and competence?	4.1 Description of research skills. 4.2 Definition of research skills. 4.3 Definition of research knowledge and attitudes.	<ul style="list-style-type: none"> <li>• Ain <i>et al.</i>, (2019).</li> <li>• Anguita-Gonzalez and Lopez (2022).</li> <li>• Cabrera Félix <i>et al.</i>, (2023).</li> <li>• Calisto-Joy (2021).</li> <li>• Castro-Sandoval and Silva (2023).</li> <li>• Mendioroz-Lacabra <i>et al.</i>, (2022).</li> <li>• Poblete-Valderrama <i>et al.</i>, (2023).</li> <li>• Quincho <i>et al.</i>, (2023).</li> <li>• Reyes-Lillo (2022).</li> </ul>
5	Classification	How are research skills classified?	5.1 Research knowledge. 5.2 Investigative skills.	<ul style="list-style-type: none"> <li>• Ain <i>et al.</i> (2019).</li> <li>• Anguita-Gonzalez and Lopez (2022).</li> <li>• Cabrera <i>et al.</i> (2023).</li> <li>• Calisto-Joy (2021).</li> </ul>



			5.3 Attitudes and values in research.	<ul style="list-style-type: none"> <li>• Castro-Sandoval and Silva (2023).</li> <li>• Cruz (2019).</li> <li>• Huddleston <i>et al.</i> (2020).</li> <li>• Mendioroz -Lacabra <i>et al.</i> (2022).</li> <li>• Reyes-Lillo (2022).</li> <li>• Sousa (2021).</li> </ul>
6	Linking	How is the development of research skills linked to digital technologies?	6.1 Research skills associated with microlearning.	<ul style="list-style-type: none"> <li>• Cabrera-Félix <i>et al.</i> (2023).</li> <li>• Castro Sandoval and Silva (2023).</li> <li>• Fuster-Guillén <i>et al.</i> (2022).</li> <li>• Hidalgo <i>et al.</i> (2021).</li> <li>• Reyes-Lillo (2022).</li> <li>• Sanchez and Rodriguez (2023).</li> </ul>
7	Methodology	What are the methodological elements for acquiring research skills through micro contents?	7.1 Microlearning format.	<ul style="list-style-type: none"> <li>• Javorcik <i>et al.</i> (2023).</li> <li>• Nurul and Rafiza (2023).</li> <li>• Yin <i>et al.</i> (2021).</li> </ul>
8	Exemplification	How is a model of research competencies defined based on the application of specialized micro contents?	8.1 Theoretical-methodological example to define a new educational model on research competencies.	<ul style="list-style-type: none"> <li>• Alarcón <i>et al.</i> (2022).</li> <li>• Cruz (2019).</li> <li>• Hidalgo <i>et al.</i> (2021).</li> <li>• Pavlova <i>et al.</i> (2021).</li> <li>• Sousa (2021).</li> </ul>

Source: Prepared by the authors with reference to Tobón *et al.* (2018).

## Results

In this research, several studies were found, both in English and Spanish, about research competencies, which have been developed in different ways, which demonstrated the complexity of the conceptual bank understood as a cognitive, procedural and attitudinal construct, since this type of capabilities is referred to with multiple terms. For the key words in English, titles with two variants were found: *research skills* and *research competencies*. On the other hand, the translation into Spanish is very variable: research or investigative skills, research or investigative competencies, capabilities, knowledge and skills in research.

With the presented organization, the following quantifiable results were obtained. The intention of this relationship is related to the fact that the variables of investigative competences and microlearning have not been linked in previous studies, at least in the universe of articles, no crossover was found in the titles, nor in the sample of 25 selected titles, nor in their summaries. Therefore, the frequency in the eight axes; it should be noted that there are articles that can be referred to in several axes, therefore, there are repeated titles in some axes, and a final summation of frequencies was not used, since this objective was not sought in this documentary study.

*et al. (2018)* will be followed, with the following sequence: Notion, Categorization, Characterization, Differentiation, Classification, Linkage, Methodology, Exemplification. Thus, in the following lines, the analysis of information between the authors that were organized in Table 1 can be seen.

### **Notion of investigative competences**

In the words of Paz and Estrada (2022, p. 2), research competencies are a construct that includes cognitive, procedural, attitudinal dimensions and metacognitive skills, among which the abilities to ask, observe, reflect, propose, use technology and methodological appropriation of research stand out.

The acquisition of these capabilities may vary depending on the field of knowledge to which the research processes are applied. According to Mendioroz-Lacabra *et al.* (2022, p. 2), research competence is essential both for professional practice and for lifelong learning, where research work, research culture and interdisciplinarity are integrated, with a vision beyond the university, seeking a positive impact on people.

The challenges of defining research competencies have various aspects, ranging from multiple conceptual constructions, integrating knowledge, skills and attitudes. Others, in which technologies, research training, scenarios and some starting points are integrated; at basic and upper secondary education levels. Since, attention has been paid to defining educational proposals with greater impact at the higher level, continuing education and postgraduate level (specifically in master's degrees, few at doctoral level) (Cabrera Félix *et al.*, 2023).

In the notion axis, the results obtained from the research focus on defining the investigative competencies, they are known as:



- Research is a substantive function of the university, aimed at the production of knowledge, training of researchers and carrying out tasks such as: searching, analysis, reflection, assessment and problem solving.
- They are linked to technologies because basic skills are a great challenge, since accessing information requires digital skills, and the study of the relationship between research and technologies cannot be ignored.
- Research skills need to be strengthened beyond what postgraduate courses offer, and gaps between teaching and research need to be bridged.
- Research skills are essential for social and educational innovation, as well as for building a basic scientific culture. They need to be integrated as cross-curricular elements of the curriculum.
- Metacognitive processes are the guiding thread of the holistic thinking that characterizes them.

The points listed above summarize the ideas highlighted by the authors indicated in Table 1. The notion of research competencies is understood as a set of knowledge, abilities, attitudes, skills and values developed to carry out an inquiry process, in which capacities for identification, discernment, analysis, search, structure, dissemination and dissemination of scientific projects are acquired.

### **Categorization of research competencies**

Research competencies have been categorized according to the disciplinary field pursued by the inquiry process, as well as the educational levels at which they have been applied. These capabilities are developed at the basic level with STEM (Science, Technology, Engineering and Mathematics) training, however, a specific type of skills or knowledge is not pursued (Long *et al.*, 2020).

Another category, which is referred to in some studies, is the investigative capacities to dynamize cognitive processes that allow us to understand, comprehend, examine, compare and assess the manifestation of complex thinking. In addition to this, reference is made to metacognitive skills, which allow the individual to pay attention to the analysis of the objects of study, to use their personality that intervenes in an ethical and critical manner, as well as to strengthen problem solving (Fuster-Guillén *et al.*, 2022, p. 27).

On the other hand, research competencies, through the influence of project-based learning, were defined as a category that allows learners to possess tools to produce analytical

capabilities and generate modular elements in research. In other words, it must be considered that science is not only the accumulation of knowledge, but also seeks to generate proposals for intervention and improvement of teaching-learning in any area (Quincho *et al.*, 2023).

Another category refers to investigative self-knowledge. This option becomes visible in terms of evaluation, since it is conceived as the estimation of acquired capacities that can be concepts, tools or behaviors that are recognized in the practice of inquiry (Esteban and Ostrovsky 2020, p. 2). The learners have dedicated themselves to identifying their own competencies, based on each of the achievements that they consider successful in the development of a project.

Within the research competencies, three basic domains were found: research knowledge, research skills and research attitudes. Regarding skills, they are the domain of actions that consider the regulation of professional activity through the scientific process, which prepares learners to access the field of knowledge through their projects (Mármol *et al.*, 2022).

For its part, knowledge mastery is linked to cognitive abilities that seek to improve the quality of teaching. That is why Poblete-Valderrama *et al.*, (2023) offered research-based learning strategies as a didactic process, in which they sought to deepen the disciplinary experience based on lifelong learning skills.

For their part, Huddleston *et al.*, (2020) offer a list of nine categories in which scientific skills are represented as part of procedural domains: topic selection, search strategy, finding resources, differentiation between types of resources, evaluation of resources, synthesis of information, summary of information, citation of resources, reading and understanding of citations.

To close this axis, it should be noted that, in accordance with the variety of categories highlighted in the results, there is an imminent theoretical and hierarchical need to focus attention on developing three levels of intervention in a new pedagogical model, in which the cognitive, procedural and attitudinal domains are considered, with greater strength in the latter.

### **Characterization of investigative skills**

In order to describe the characteristics that represent investigative competencies, the three domains mentioned in the categorization axis are reviewed. A relationship with the teaching-learning process was established for the acquisition of each of them.

### Domain or conceptual level

The teaching-learning process can be adapted to the context and to the different needs of the subjects. The conceptual domain refers to the knowledge that is acquired, the identification of the retention capacity, the concentration time and the focus on the points of interest. In combination with the *microlearning proposals* that have been built for other areas, the conceptual level has its context in the following characteristics (Abdulrahman and Rutatola 2021, pp. 67-69):

- Knowledge is pursued in a theoretical learning objective, which is simplified and specific to the retention of a fragment of the subject, which is adapted to small standards.
- Micro-units have been shown to enable new learners to easily absorb ideas, concepts and instructions and apply them in specific learning contexts, thanks to their relationship with the digital age.
- Micro knowledge in the formation of competencies finds its relationship with the relevance of learning experiences, which are focused on offering a contextual relationship and the portability of information.

In this way, the aim of training in research skills is to relate understanding to the knowledge involved in the development of inquiry processes, in which the learner identifies the necessary theoretical references and the foundations that allow him/her to carry out a project, including its approach, justification and conceptual framework.

### Procedural mastery

For the development of investigative competencies, it is necessary to employ pertinent teaching-learning strategies with a socio-cognitive approach, in accordance with complex thinking, the current context and the ethical construction of an inquiry project. For this reason, the characteristics that the strategies must possess require the following elements (Fuster-Guillén *et al.*, 2022, pp. 27-28; Sánchez and Rodríguez, 2023, pp. 2-4):

- Relationship between what is taught and what is learned: it tends to be a pedagogical strategy in which teachers are trained in relation to the training lines that are to be applied in research projects.
- Curricular transversality: this means that research skills have a transversal impact on all, or at least on almost all, subjects in a curriculum. In this way, students can develop problem-solving skills and establish a close relationship

between theory and practice, with reference to the scientific knowledge of their discipline in training.

- Educational and thematic context: pedagogical strategies must be classified according to the context (which is defined first of all by the educational level it addresses), according to the disciplinary topic, as well as establishing the methodological route and theoretical approach. With these elements, teaching-learning strategies of at least three types can be developed: 1) for the problematization of reality and with a holistic approach; 2) inquiry and search for theoretical verification; 3) confrontation of reality with theory. All of them linked through an attitude of awareness and ethical commitment.

- Gradual pedagogical strategies: training in research must be an interconnected line between academic degrees, ranging from basic education with tasks specific to their capabilities, and consolidated at the postgraduate level, with the development of applied research and intervention projects.

- Feedback: The relationship between individual work, collaboration and the products resulting from research processes requires evaluation and feedback.

- Individual and collaborative relationship: depending on the case, the teaching-learning method must start from the initial objective. In the case of research, it is required that, in addition to being a goal of the project, the learning acquired during the inquiry process also has a diversification of individual and collaborative work strategies. In this way, all members will feel adapted and will assume specific roles.

- Metacognitive tools: allow students to consolidate awareness, identify knowledge, and theorize and justify their abilities.

To achieve procedural mastery, various pedagogical strategies are characterized that make specific reference to tools and steps to follow, so that the teaching-learning process in research allows subjects to strengthen their capacities. For undergraduate and graduate levels, according to Cabrera-Félix *et al.*, (2023), based on the need of students, pedagogical solutions or strategies for problems related to work scenarios and in society are provided by implementing research competencies.

### Attitudinal domain

Attitudes, values, conducts, ethical thought patterns and behavior are the set of actions that represent the prevailing interventions of the subject in the research process; they are an area that has been little explored in the studies found. That is why, within the aspects with the greatest need is this domain, which goes from its conceptualization to the type of tools necessary to positively impact the research tasks.

Therefore, Fuster-Guillén *et al.*, (2022, pp. 27-28) recommend that the integration of axiological strategies is necessary, with a solid foundation for the transformation of appropriate behaviors and conduct in interventions. Given its complexity, regarding training with descriptive, analytical and critical approaches to consolidate certain capacities and begin in the investigative field.

In this study by Fuster-Guillén *et al.*, (2022), ten factors emerging from fieldwork with specialists in research methodologies were highlighted, since they consider that an adaptation of the curricular aspects is required; among these, the notable ones for the attitudinal domain are: the psychological factor, the orientation of the document and the ethical factor in research.

1. The psychological factor refers to emotional and sensational capacities, whether of enjoyment or displeasure with the project, as well as motivational influence. Likewise, it is necessary to pay attention to negative elements and disinterest.
2. The teacher orientation factor tends to focus its attention on the relationship that the teacher establishes with the student, based on the support that he offers, as well as the perception that he reflects in the student, one of the variables to consider is the imitation of behaviors.

### Differences between research skills

Based on the three most relevant categories: conceptual, procedural and attitudinal domains, this segment presents the differences between their descriptions. Accordingly, Table 2 contains the authors and the references they make to each of the terms.

**Table 2.** Differentiation of terms between research competencies

Terms	Description according to authors
Investigative knowledge	<p>Identification, selection, production, generation and dissemination of knowledge, which serves to satisfy various human needs. It guides the research process for the construction of new knowledge. It integrates various thinking skills that allow the subject to apply actions to observe, discover, consult, interpret and develop knowledge (Quincho <i>et al.</i>, 2023).</p>
Investigative skills	<p>They are the set of capacities and skills that human beings perform in accordance with 21st century skills. They provide dynamism to learning. They integrate the instrumentation of optimal tools for the research process (Castro-Sandoval and Silva, 2023, pp. 21-22).</p> <p>For Poblete-Valderrama <i>et al.</i>, (2023), the main skills involved are: analysis, reflection and argumentation. They are applied through routines of reading, synthesis and analysis of scientific information.</p> <p>While Reyes-Lillo (2022) describes skills as informational, in the aspect of academic publication, these serve to build an intellectual framework, understand, find, evaluate and use information, which allows the academic community to communicate through technological resources, the results of their teaching, research and social activities (in the case of undergraduate and graduate).</p> <p>For their part, Ain <i>et al.</i>, (2019) classifies research skills in relation to the employability of university students, defining that lifelong learning, research, cultural and emotional awareness and critical-analytical thinking are what stand out among the best job fields.</p>
Research skills	<p>In the words of Mendioroz-Lacabra <i>et al.</i> (2022), research competencies are specific to the act of research, with the logic of the scientific method, it is linked to generic, metacognitive skills and all the actions that a researcher must follow. It addresses the practice in a systematic way to successfully achieve problem solving, through research projects.</p> <p>From another perspective, Cabrera Félix <i>et al.</i>, (2023) add that in addition to the listed capabilities, which integrate three levels, cognitive, procedural and attitudinal, it is important to highlight that these types of competencies have a great impact on the social and work success of the people who acquire them.</p> <p>In the research by Anguita-González and López (2022), the competencies are known as informational investigative competencies, which refer to the combination of the process of information selection, discernment and dissemination of knowledge. In this way, they join the previous authors in saying that the construct is broad.</p>
Investigative attitudes	<p>It is a little-explored factor and allows the development of positive or negative, erroneous or unethical behaviors. It is associated with avoiding</p>

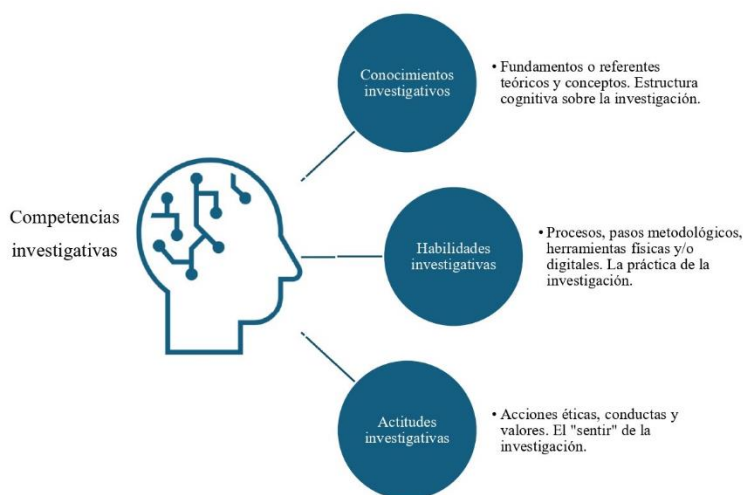


	bad research practices, avoiding fraud, plagiarism, academic dishonesty, misleading advertising, violence (of any kind, depending on the context of the project), and the manipulation of bibliographic references (Fuster-Guillén <i>et al.</i> , 2022, p. 28).
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Source: Prepared by the authors based on the authors cited in each of the terms.

All the elements make up the term of competencies, they are described individually, they are a set of components (Figure 1), and they lead to the achievement of a research process that generates certain results.

**Figure 1.** Components of investigative competence



Source: Own elaboration.

In other words, research competencies include: a cognitive structure, a practice and a sense of research. In a complex way, it is difficult to have a specific list of the capabilities that are achieved in each of the descriptors. Hence the repeated need to define a pedagogical model suitable for these spheres.

### Classification of research skills

In relation to the differentiation found in the way competencies are constructed, for this segment the results are aligned based on three classifications: research knowledge, research skills, attitudes and values in research.

### **Research knowledge**

It is conceived as the production of scientific knowledge, it is the transformation of data into information, in turn, it offers wisdom to human beings. It is articulated in theory, with the impact of research on three fundamental aspects: the problem to be solved, the object of study and the representation of the results (Castro-Sandoval and Silva, 2023, p. 21).

It allows human beings to be able to learn effectively about their reality, refers to the logic of the scientific method, and seeks to problematize in a systemic, reflective, open and creative way (Mendioroz-Lacabra *et al.*, 2022, p. 2).

It enriches research training through the democratization of knowledge as a valuable resource to identify different voices and forms of knowledge. In order to create a system of knowledge and validation of creative and free practices (Sousa 2021, p. 4).

### **Investigative skills**

Set of capabilities that allows individuals to solve challenging situations, problems, questions, establish importance in research, thinking skills, communicative aspects, development of proposals, argumentation and improvement of practices, both in writing and construction of products, to strengthen the appropriation of scientific research (Castro-Sandoval and Silva, 2023, p. 22).

They are classified as cognitive, communicative, interpersonal, observational and reflective; for questioning, procedural, analytical and propositional. This whole set of skills allows the application of strategies, tools and processes for scientific research (Calisto-Alegría, 2021, p. 206).

Within the classification, there are also skills that are inserted in academic and research activities, such as: recognition of the need for information, search planning, location of resources, assessment and understanding, interpretation and organization, communication, evaluation of the process and results (Reyes-Lillo, 2022, p. 2).

### **Attitudes and values in research**

It is the ethical, emotional and attitudinal aspect that represents the honest, integral and reliable design of a research work. It incorporates critical thinking and awareness, both of ethics and political issues associated with the use of information (Anguita-González and López, 2022).

It includes a reflective-critical attitude regarding the use of information, copyright, and bad plagiarism practices (Castro-Sandoval and Silva, 2023). It promotes an attitude of permanent research and interest in discoveries with a positive attitude (Mendioroz-Lacabra *et al.*, 2022, p. 10). It integrates autonomy, responsibility, consolidation of an identity, respect, humility, and love for the task to be performed (Calisto-Alegría, 2021).

### Linking research skills

As part of the training processes that have been applied at different educational levels, the use of virtual learning environments, distance education, virtual education, *mobile learning*, integration of *chatbots* and use of technological tools were found (Table 3).

Therefore, the relationship between research skills and technology has not gone unnoticed. Each of the studies offered its results, some more successful than others. However, due to the type of construct, which is subdivided into multiple types of knowledge, skills and attitudes, it has not been the subject of study or proposal to establish a relationship between research skills and *microlearning*.

**Table 3.** Link between research skills and e-learning.

Relationship	Description
Virtual learning context	A mixed modality via Zoom and asynchronous on an educational platform was used to teach a virtual course on research skills, with which favorable results were obtained in: information search strategies, processing, analysis, writing, and textual review (Sánchez and Rodríguez, 2023).
Individual research factor	Research capabilities integrate computer tools and databases into the individual research factor to investigate, search, select, collect, process information and obtain results. Among this list of capabilities, the potential based on the scientific method and its management in a research project can be observed (Fuster-Guillen <i>et al.</i> , 2022, p. 28).
Implementation of digital technologies	The field of research competencies establishes the importance of research in pedagogical practice, the development of thinking skills, improvement in communication processes, propositions, solutions and construction of decision-making, argumentation and writing and dissemination practices. When mediated by technologies, they allow creativity, pedagogical innovation and a response to learning in the digital age. They are classified into different areas (Castro-Sandoval and Silva, 2023, p. 26):

	<ul style="list-style-type: none"> <li>- Technological</li> <li>- Pedagogical</li> <li>- Communicative</li> <li>- Management oriented</li> <li>- Research</li> </ul>
<p>Use of technological tools</p>	<p>At the postgraduate level, especially in master's and doctoral degrees, research has been influenced by technological tools with a high impact. Since the substantive functions of searching, analysis, coding and product construction are mediated by these tools. The level of satisfaction depends on the technological skills that are developed for the research processes, because technological tools facilitate the research processes (Cabrera Félix <i>et al.</i>, 2023).</p>
<p>Flipped classroom on virtual platform</p>	<p>The flipped classroom model allows for a greater cognitive effort to be developed that can be carried out in self-study spaces, either from home or a comfortable place for the student. With technological integration, the model can be used, in addition to the combination of synchronous and asynchronous work. For this reason, virtual platforms are implemented where the contents selected by the teacher are reviewed by the student, and with various strategies through autonomous learning, the student strengthens his commitment. On the part of the teachers, in addition to knowing the pedagogical model, it is also necessary to master the methodological process of research. In this way, they will be able to accompany their students through the flipped classroom model. The results obtained indicated that before the experience, the students were unable to identify their research skills; after the flipped classroom proposal on a virtual platform, they achieved an outstanding level (Hidalgo et al., 2021, p. 190).</p>
<p>Information skills and publishing tools</p>	<p>A study that crossed information skills and research skills highlighted that, if the researcher is related to the expertise of a librarian, results such as (Reyes-Lillo, 2022, p. 165) can be obtained:</p> <ul style="list-style-type: none"> <li>- Teaching and planning in the project</li> <li>- Integration and updating of references</li> <li>- Scientific communication, social media promotion and visibility</li> </ul> <p>To this end, they implemented a course on scientific skills through the educational technology department, with the result of:</p> <ul style="list-style-type: none"> <li>- Using bibliographic databases</li> <li>- Knowledge of bibliometric indicators for the selection of scientific information</li> <li>- Using software for automatic reference creation</li> <li>- Knowledge of the main elements of scientific communication and publications</li> <li>- Using tools and technologies for academic publishing</li> <li>- Application of techniques and tools to promote the visibility of academic publications</li> </ul>

Source: Prepared by the authors , based on consultation of the authors indicated in each of the relationships presented.

From all the studies linked to digital technologies, it was deduced that there are still opportunities to implement research skills, since satisfactory results have been obtained, but they have been appropriate to each of the contexts presented in the research. Therefore, in another context where certain educational needs are met in which the implementation of pedagogical technological strategies based on a *microlearning format is allowed*, it still needs to be explored.

### Methodology for research competencies

In the methodology axis, we sought to identify and/or describe the key elements or steps to apply the concept. In this case, we talked about a model of investigative competencies through micro-learning, so three articles were related on how it is possible to define a new pedagogical model.

According to Nurul and Rafiza (2023, p. 269 ), the learning model known as *microlearning* was applied to adverse scenarios (cases such as the COVID-19 pandemic), with effective, student-centered, interactive proposals and with properly planned instruction, they have gained popularity.

On the other hand, micro learning was defined as a learning process through small portions of activities, which have been designed in a concise manner and focused on small fragments and short lessons (Nurul and Rafiza 2023, p. 269). Mainly, the learning model makes use of content that focuses on small topics (Yin *et al.*, 2021). By being related to the research process, the conceptual level would have its way through different types of resources with theoretical references.

With reference to Javorcik *et al.* (2023, p. 13) *the global perspective of the microlearning* model can be used in diverse educational systems, those that offer the demand for new concepts, educational strategies, which can be determined in different places, times, processes, tools and based on the use of short-duration *web content*.

By practicing an instructional design methodology based on the *microlearning model* to enhance research skills, according to the results of Yian *et al.* (2021, p. 156), micro learning is required to allow interaction in different dimensions, in content, duration, level of the curriculum, process, mediation and the type of learning depends on the progress and ease that students find.

For research processes, the methodology can be adaptive to a research objective, requirements, procedures and decision-making based on the problem. For this, micro learning offers small fragments of information that imitate the way the brain constantly seeks to resolve conflict situations, and can be methodologically suitable to improve the experience and learning results in research.

### **Exemplification of investigative skills**

Based on five studies on competencies or skills and their possible relationship with micro learning, the need for a new pedagogical model is defined in the following lines.

- Development of detailed skills through learning activities that include: research methodological framework, information search and analysis, management of research tools (Hidalgo *et al.*, 2021, p. 191).
- Teacher training in research teaching, at different educational levels, has a great impact, is little explored and it is necessary to design, implement and evaluate training programs or proposals that are integrative and that facilitate practice (in cases that require it) (Alarcón *et al.*, 2022, p. 2).
- Research competencies should be formative processes that enrich school curricula and teaching practices, beyond STEM training, since a large part of the proposals support the adaptation of study plans that lack methodological guidelines in exact sciences such as mathematics, with an engineering influence, due to the degree of autonomy they offer (Pavlova *et al.*, 2021).
- Consolidation of a scientific community appropriate to each educational context. According to the results obtained by Sousa (2021), the members of a community adapted to each of the contexts make it possible to counteract the inefficiencies of research. That is, to ground the reflections in the pedagogical practice itself for research. This provides a methodological reference where research skills normalize subjectivities and lead to understanding that they can establish various relationships with multiple fields of study and/or professions.
- The gaps between teaching and research, especially for universities, refer to the lack of research skills in the various fields of knowledge, both in the teaching staff and in students (higher and postgraduate level), in particular, they do not really adapt to the difficulties that students face in the labor field once they graduate (Cruz 2019).



*microlearning* model and how they are structured were listed, according to the axes of characterization and methodology. On the other hand, in relation to the classification axes, some studies were selected that could serve as an example, with which the arguments of the last list were offered. With this, it is intended that in the conclusions the intersection of the variables of the study is clear, as well as the answers to each of the research questions listed in Table 1.

## Discussion

The research process applied in different disciplinary fields tends to pursue various objectives, among them, according to some authors, for example, Cabrera Félix *et al.*, (2023), Mendioroz-Lacabra *et al.*, (2022), Paz y Estrada (2022) allows participants to recognize their capabilities while experiencing, living and pursuing the purposes of their projects. That is, there is a need to propose a model by research competencies that gives relevance to the conducts and behaviors that allow learners to understand their environment, while developing new capacities. Various categories were found:

- STEM training, pertaining to the integration of science and technology with reference to engineering and mathematics.
- Research capabilities as a broader construct than competencies, focused on metacognitive skills.
- Tools for project-based learning.
- Self-assessment and self-knowledge in research, from the perspective, intrinsic motivation and achievements of each learner.
- Mastery of investigative skills with greater emphasis, leaving aside attitudes.
- Teaching process with a focus on investigative knowledge, without paying attention to behaviors.
- The focus on learning the scientific method sought to establish that knowledge in quantifiable disciplinary areas is optimal, leaving aside the social sciences and humanities.

It was confirmed that, of the three domains described in the characterization, attention should be paid to research attitudes, because they are named in different ways, either as an axiological approach or as psychological cognitive capacities, and have been references with

little analysis. According to the results of the different axes of analysis, the attitudinal elements that intervene in the formation of research competencies are omitted.

As can be seen, analytically there are differences between each of the terms used to describe the investigative competencies in the axis of differentiation. Knowledge is the cognitive sphere in which the subject forms in his mental structure all the meanings and concepts derived from the act of inquiry. On the other hand, the procedural part is the application of the concepts, use of tools, platforms, software or all the resources, both physical and technological, that allow the researcher to carry out his scientific method. Likewise, the attitudinal part is the set of actions, behaviors, and in essence, the ethical part of the practice of research.

From the results collected, it was possible to reflect on the link that has been made at the application level; various proposals through digital learning environments have been used, without a doubt, research skills have been an impact of technologies in different aspects, whether as a means of learning, support for the development of research or training on the subject. They have been directly related to digital skills, technological and informational instrumentation. Likewise, it should be noted that training for the use of digital resources such as reference managers, recognition of advanced search strategies and/or publication processes, are also considered to have great value and influence.

According to the linking axis, research competencies have been worked on in virtual contexts, implementation of digital technologies, use of technological tools, flipped classroom model in relation to a virtual platform and information skills. Among these possibilities, it was highlighted that research competencies require communicating in different technological formats, with a methodological approach focused on the student, enhancing theoretical domains, research qualification and different attitudes.

Among the results obtained, no specific examples were found in which micro learning had been implemented to consolidate research competencies. For this reason, in this axis, possible approaches of methodological theoretical support were classified to define a new pedagogical model on the development of this type of competencies.

## Conclusions

The investigative competencies that would be presented in a proposal to determine a new pedagogical model are intended to be attributed to complex levels of knowledge. Based on the research, the need was found to synthesize the accumulation of data from the investigations, link knowledge with some motive or interest, and, from this, learn continuously. In this way, the role of the student is characterized by being a consumer and processor of large amounts of knowledge, he is known as a prosumer, he represents himself, his collaboration capabilities, and sometimes, interacts with others who have the same interests in learning.

The research process in different disciplinary fields seeks various objectives, such as allowing participants to recognize their capabilities while developing their projects. A model of research competencies is required that emphasizes behaviors that allow learners to understand their environment and develop new skills. The identified categories include: research capabilities focused on metacognitive skills, project-based learning tools, self-assessment and self-knowledge, and mastery of research skills.

The knowledge-focused teaching process is highlighted by the importance of investigative attitudes, which are often poorly analyzed. The results underline the influence of technologies on investigative skills and the need for a pedagogical model that includes the use of digital resources, information skills and student-centered methodological approaches. No examples of microlearning were found to consolidate these skills, suggesting the need for new pedagogical approaches, therefore, for future research it is an optimal area of intervention.

This is why, through *microlearning*, it is possible to self-manage and self-motivate the acquisition of very specific processes in various areas of knowledge, with individual strategies, which subsequently have a very significant collaborative impact. The content is structured in a way that can be in *small chunks* or in small pieces. This means that the study time will be around 10 minutes, which is ideal for it to be effectively incorporated into the learning path.

*self-paced learning* trend is adaptable to your daily life, your interests and self-management, it is determined by self-organization, decision-making to select the content and it is more attractive for the learner. The personalization of the learning experiences, the multiple possibilities of learning objects in the content ( *blogs*, forums, diagrams,

infographics, pdf's, interactive, *tests* , among others), are based on the selection determined by the user himself.

With a microlearning format, production costs and times are reduced, because there is a specific itinerary, planning and production of lessons limited to the learning objective. In addition, it can be linked to multiple technology options, if possible, free access is allowed or the resources are hosted on open source tools.

The findings mentioned above in the eight axes allow the development of the proposal of the model of investigative micro-competences, which will lead the student to be autonomous in his own processes, resolve situations, self-regulate times and activities, in order to form the expected learning. Likewise, it will consider autonomous learning, so that through a self-regulated process of cognitive mechanisms, users are allowed to acquire and store ideas and information from any field of knowledge, by containing research skills and tools.

### **Future lines of research**

It is inferred that there is an imminent opportunity to define a model in which learning is gradually enhanced and large areas of competence are consolidated as the student achieves each of the micro units of study. This article defines eight axes that will allow its construction; however, the development of the training proposal is lacking to validate the findings broken down here.

On the one hand, in future lines of research it is relevant to include the eight axes of analysis for the development of research competencies, thereby executing research projects based on the relationship between theory and practice in various multidisciplinary contexts.

Finally, it is relevant to consider educational technology, in which the variables of investigative competences, investigative skills or the relationship between teaching and research are considered. In turn, the interaction between investigative competences, with the use and application of *microlearning*, through pedagogical proposals.

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Rol de Contribución	Autor (es)
Conceptualización	Fátima Guadalupe Márquez Silva
Metodología	Fátima Guadalupe Márquez Silva y Rocío Edith López Martínez (apoya)
Software	Fátima Guadalupe Márquez Silva
Validación	Fátima Guadalupe Márquez Silva y Rocío Edith López Martínez (apoya)
Análisis Formal	Fátima Guadalupe Márquez Silva
Investigación	Fátima Guadalupe Márquez Silva
Recursos	Fátima Guadalupe Márquez Silva
Curación de datos	Fátima Guadalupe Márquez Silva
Escritura - Preparación del borrador original	Fátima Guadalupe Márquez Silva
Escritura - Revisión y edición	Fátima Guadalupe Márquez Silva y Rocío Edith López Martínez (apoya)
Visualización	Fátima Guadalupe Márquez Silva y Rocío Edith López Martínez (apoya)
Supervisión	Fátima Guadalupe Márquez Silva y Rocío Edith López Martínez (igual)
Administración de Proyectos	Fátima Guadalupe Márquez Silva y Rocío Edith López Martínez (apoya)
Adquisición de fondos	Fátima Guadalupe Márquez Silva y Rocío Edith López Martínez (principal)