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Research competencies for the design of a nuclear curriculum: a systematic review

Competencias investigativas para el diseño de un currículum nuclear: revisión sistemática

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Abstract

The present study focused on the organization of a nuclear curriculum and its relationship with the development of investigative skills. Its main objective was to analyze existing experiences on the implementation of nuclear curricula with the purpose of proposing a strategy to enhance research competencies in teachers and researchers in Ecuador. To this end, a systematic review of the literature was carried out following the principles of the PRISMA declaration. The search was carried out in Google Scholar, selecting 34 articles that address the conception of the nuclear curriculum, its relationship with medical training and science teaching, as well as approaches for the development and evaluation of research competencies. The results highlighted the importance of implementing a core curriculum with research competencies as a crucial tool to guarantee essential skills and promote research in the educational field. Key practices such as interdisciplinary collaboration, early orientation toward research projects, and the use of technologies to enhance research teaching were identified. Finally, it is concluded that the effective implementation of a nuclear curriculum with investigative competencies requires appropriate pedagogical strategies that promote research as an integral part of the training process.

Keywords: research skills, core curriculum, systematic review, higher education

Resumen

El presente estudio se centró en la organización de un currículum nuclear y su relación con el desarrollo de competencias investigativas. Su objetivo principal fue analizar las experiencias existentes sobre la implementación de currículos nucleares con el propósito de proponer una estrategia para potenciar las competencias investigativas en docentes e investigadores en Ecuador. Para ello, se realizó una revisión sistemática de la literatura siguiendo los principios de la declaración PRISMA. La búsqueda se llevó a cabo en Google Académico, seleccionando 34 artículos que abordan la concepción del currículum nuclear, su relación con la formación médica y la enseñanza de las ciencias, así como enfoques para el desarrollo y evaluación de competencias investigativas. Los resultados destacaron la importancia de implementar un currículum nuclear con competencias investigativas como una herramienta crucial para garantizar habilidades esenciales y fomentar la investigación en el ámbito educativo. Se identificaron prácticas clave como la colaboración interdisciplinaria, la orientación temprana hacia proyectos de investigación y el uso de tecnologías para mejorar la enseñanza en investigación. Finalmente, se concluye que la implementación efectiva de un currículum nuclear con competencias investigativas requiere estrategias pedagógicas adecuadas que promuevan la investigación como parte integral del proceso formativo.

Palabras clave: competencias investigativas, currículum nuclear, revisión sistemática, educación superior

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Introduction

The “nuclear curriculum” represents the essential core of any study plan, serving as the foundation upon which the entire educational structure is built. Originally associated with medical training, this concept has evolved to encompass various fields of knowledge, including education. In Ecuador, for example, the implementation of a nuclear curriculum is reflected in Resolution RPC-SO-19-No.213-2015, which establishes a minimum curricular structure for higher education programs.

Beyond its origins in the medical field, the nuclear curriculum stands out for its relevance and durability, acting as a solid foundation upon which other curricular components are structured. Its key characteristics—efficiency, flexibility, hologrammaticity, consistency, and evaluability—ensure its adaptability and continued relevance in various educational contexts (Loureiro et al., 2015; Marcondes, 1996). In this study, its significance lies in providing an effective reference framework for higher education training. However, the results of the literature review indicated that there are no documented experiences of its application in other fields of knowledge (Ahn & Bomback, 2020; Bandaranayake, 2000; Harden & Davis, 1995).

Moreover, implementing a nuclear curriculum involves identifying key competencies, defining learning objectives, selecting fundamental content, organizing it sequentially, integrating interdisciplinary approaches, and incorporating appropriate assessment methods (Marcondes, 1996). These implementation strategies contribute to building a solid and effective curriculum that prepares students to face labor market challenges and contribute to societal development.

In this context, discussing competencies entails delving into a conceptual universe that allows for an understanding of the true essence of the educational activity related to them. From a holistic perspective, competencies are defined as a “cognitive complex” that encompasses a variety of interrelated elements that converge to form a coherent whole (Mendoza, 2008). This integrative approach is supported by various authors who argue that competencies are not limited to content mastery but also include skills, emotions, values, and attitudes that operate in relation to expected performance (Ceballos, 2020).

In particular, research competency emerges as a crucial element in the academic and professional fields. It is defined as a comprehensive set of knowledge, attitudes, skills, and abilities necessary to conduct research successfully. It involves the ability to acquire and apply research methodologies, critically analyze information, solve problems, and contribute to advancing knowledge in a specific area (Ayala, 2020; Barón, 2020; Reiban et al., 2017; Galvez, 2022; Hernández Suárez et al., 2021; Maldonado et al., 2007; Moscoso & Carpio, 2022).

The main objective of this study was to analyze existing experiences regarding the implementation of nuclear curricula to develop a strategy that strengthens research competencies in teachers and researchers in Ecuador. This research aimed to understand how nuclear curricula have been structured and applied in different contexts, focusing on identifying successful practices and lessons learned that can be adapted to the Ecuadorian educational environment. By focusing on research competencies, the study aimed to enhance not only teachers’ ability to conduct high-quality research but also to foster a culture of research within educational institutions. This meant

that nuclear curricula should not only ensure the acquisition of fundamental knowledge but also promote the development of critical thinking, methodological skills, and problem-solving abilities, integrated within an interdisciplinary approach. Strengthening these competencies is essential for advancing educational innovation and generating new knowledge, positioning education professionals as key players in developing research that addresses the country's social and academic needs.

1.1. Nuclear Curriculum

The "nuclear curriculum" represents the central and essential part of any educational program's study plan, encompassing the knowledge, skills, and competencies considered fundamental for achieving the proposed educational objectives. This section of the curriculum is characterized by its relevance and permanence, allowing it to serve as a solid foundation upon which the other curricular components are structured. Its design responds to the need to identify the basic and essential elements that any academic program, regardless of its level of specialization, must include to ensure comprehensive training (Reis et al., 2016). In this way, the nuclear curriculum establishes a common framework that facilitates the transmission and assimilation of necessary knowledge, contributing to students' professional development (Moreira Siquiera & Fortuna, 2022).

The nuclear curriculum originated in the medical field, and over time, its application has expanded to other areas, such as in Ecuador, where the Higher Education Council has adopted this approach to structure higher education training in the educational sector (Higher Education Council, 2015). Although the first documented experiences of its implementation date back to the 1980s, its potential extends beyond medicine, providing a coherent and adaptable structure for various academic and professional contexts. This approach aims not only to ensure that students acquire the fundamental knowledge of their discipline but also to promote scientific research as a constant activity within educational institutions, thereby strengthening academic productivity and development.

1.2. Competencias investigativas

The concept of competency refers to an individual's ability to mobilize a set of knowledge, skills, attitudes, and values that enable them to perform adequately in specific contexts (Mendoza, 2008). In the educational field, research competencies are defined as the necessary capacities to effectively carry out research. These competencies encompass the mastery of research methodologies, the critical ability to analyze information, problem-solving, and contributing to the advancement of knowledge in a given discipline (Castro, 2020).

Research competencies are structured into three levels: basic, complementary, and advanced. Basic competencies include the fundamental skills that every researcher needs to undertake scientific work, such as formulating research questions, collecting and analyzing data, and interpreting results. At the complementary level, skills related to communicating findings, both in academic settings and through formats accessible to diverse audiences, are included. Finally, at

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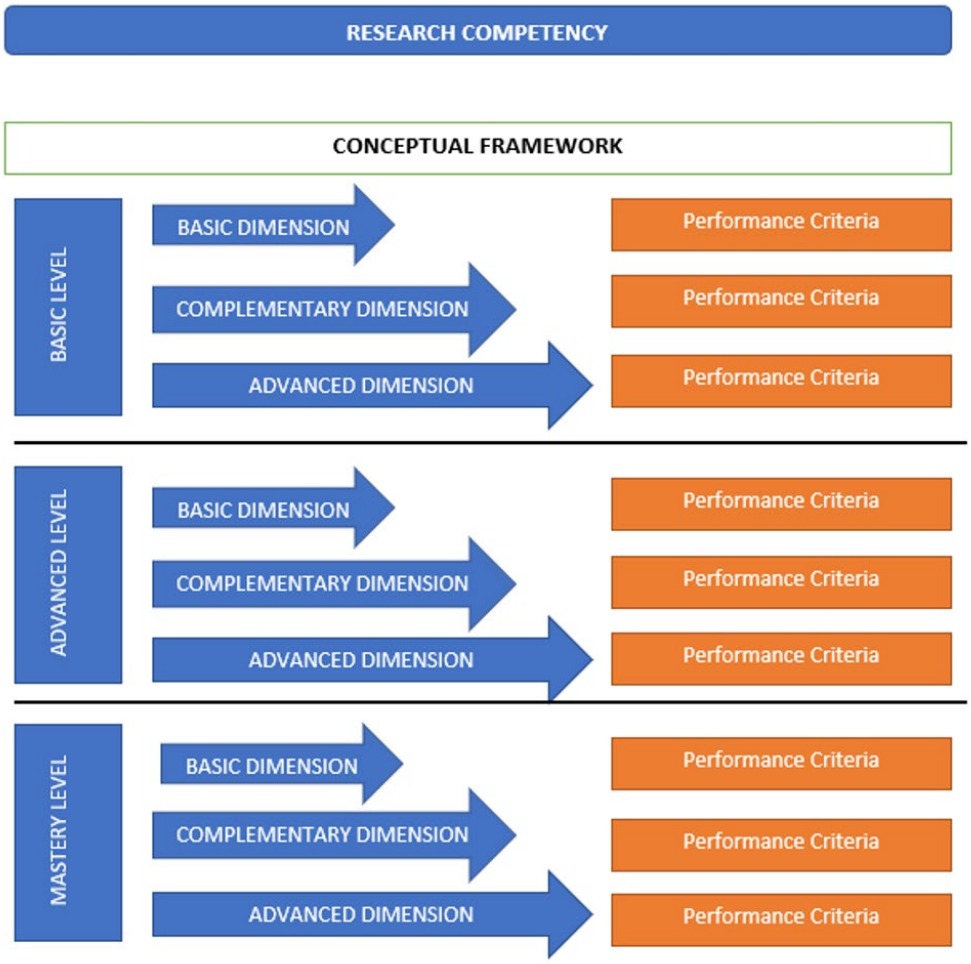
the advanced level, competencies such as leadership in research projects and the ability to manage resources and work teams stand out (Quezada et al., 2020).

These competencies are essential not only for students but also for teachers, who must be capable of guiding the research process and fostering a research-oriented culture in the academic environment. Adapting to the specific characteristics of each field of knowledge, research competencies enable professionals to address the challenges of their respective disciplines and contribute to the development of new knowledge. The structuring of these competencies is key to comprehensive training and the promotion of a research culture within the educational system. *Figure 1* illustrates the curricular structure used in this study to conceptually develop research competency.

Figure 1

Curricular Structuring of Research Competency.



Methodology

The systematic literature review has been used for more than three decades, primarily in the health field, and has recently gained relevance in disciplines such as Social Sciences. Its usefulness in education is justified as it allows decision-makers to support their proposals with scientific evidence and promote the integration of policy, practice, and research. This type of review follows a rigorous methodology to identify, analyze, and interpret studies related to a specific research question. The PRISMA statement, one of the most widely used guidelines, establishes a structured process in four phases: identification, screening, eligibility, and inclusion, ensuring transparency and repeatability in the process.

In this study, a review was conducted within a documentary research framework (Páramo, 2020), following the principles established by the PRISMA statement (Moher et al., 2009) according to its flowchart and checklist. This systematic review was carried out using the Google Scholar search engine, which currently offers extensive coverage and includes a wide range of scientific articles. The article search was conducted in 2023 using English-language keywords derived from the literature and the UNESCO Thesaurus: research competencies, nuclear curriculum (*Table 1*).

Table 1

Search Equation.

Search Equation
TITLE-ABS-KEY ((core curriculum) AND (research skills OR research competencies))

The retrieved articles were examined after applying the following inclusion and exclusion criteria in the initial phase:

1. Works published up to 2022.
2. Articles in Spanish, Portuguese, and English.
3. Articles corresponding to empirical studies, excluding book chapters and conference proceedings.
4. Documents that include the analysis of research competencies and nuclear curriculum.

After applying the publication year filter, 246 documents were obtained. A second filter was then applied using language criteria (English and Spanish, excluding Portuguese documents), resulting in 128 articles. In the initial phase, the titles, abstracts, and keywords were carefully reviewed according to six inclusion criteria, from which 34 articles were selected, as shown in the flowchart and the four stages of the systematic review in *Figure 2*.

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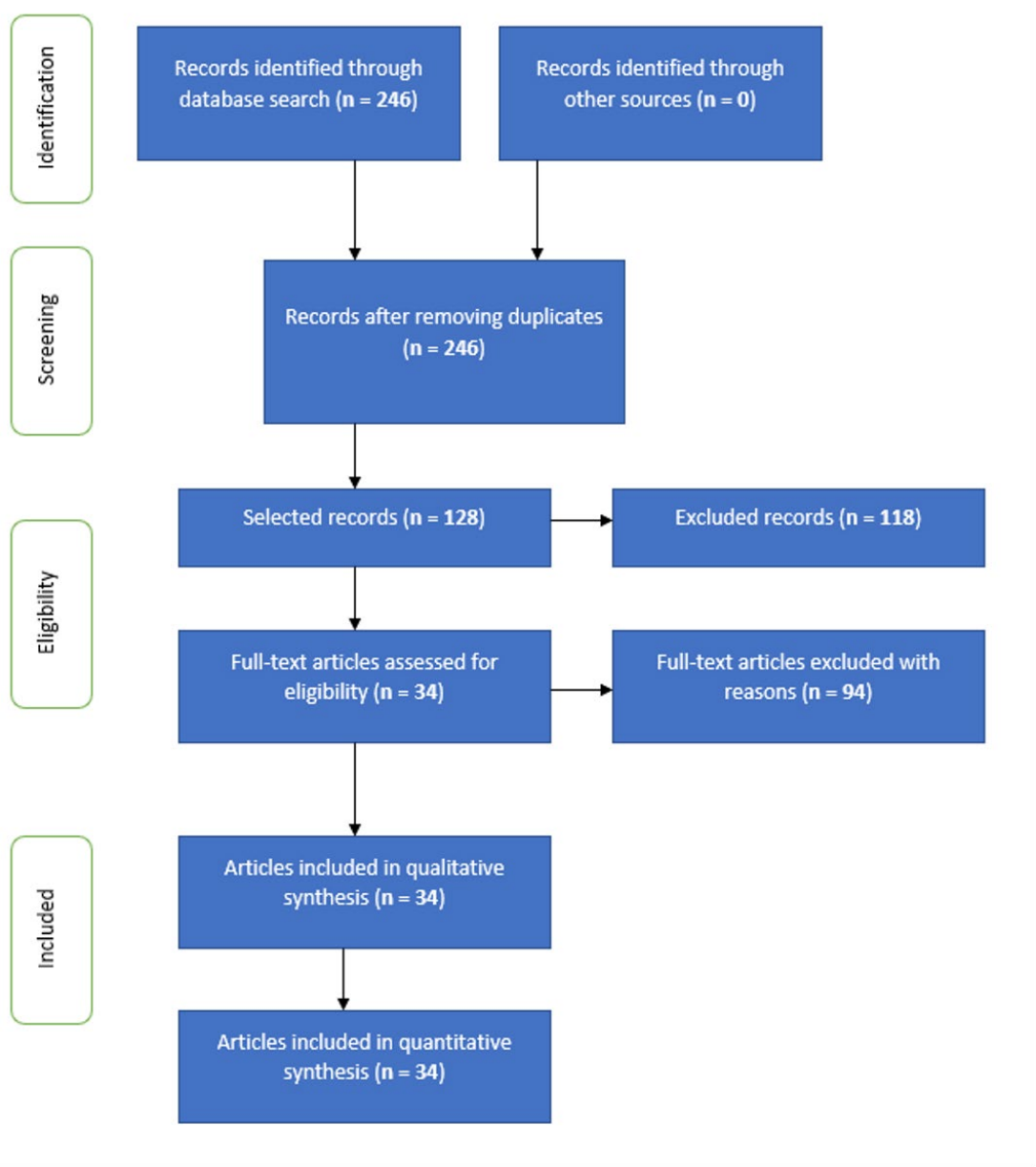
Figure 2

Systematic Review Flow Diagram.



Of the 34 articles resulting from the search described previously, according to the inclusion and exclusion criteria, a content analysis was conducted considering the following elements (*Table 2*):

1. Concept of the nuclear curriculum: definitions of the concept under study.
2. Nuclear curriculum and medical education: studies related to medical training.
3. Nuclear curriculum and science education: studies related to science teaching.

Regarding the second dimension of the study, the classification criteria were as follows:

1. Approaches to developing research competencies
2. Training in research competencies
3. Instruments for evaluating research competencies
4. Research competencies of faculty members
5. Research competencies in students

The main research findings that address the research questions or objectives were presented.

Results

The implementation of a nuclear curriculum in professional training has been a subject of interest and debate in the educational field, particularly concerning the integration of research competencies. This approach aims to ensure that students acquire a core set of skills and knowledge necessary for professional practice while also fostering the development of research skills, which are essential in the healthcare field.

Over the years, various experiences have been carried out to characterize and understand the benefits, challenges, and best practices associated with implementing a nuclear curriculum that includes research competencies.

The introduction of a nuclear curriculum is based on the idea of providing a solid and standardized foundation of essential knowledge and skills for all students, regardless of their specialty or area of interest. This approach seeks to standardize learning experiences and ensure that all graduates are equipped with the necessary competencies to tackle professional training challenges.

Previous experiences in implementing a nuclear curriculum with research competencies have yielded varied results and valuable lessons. Firstly, it has been observed that integrating research competencies can enhance professional training by promoting critical thinking, problem-solving, and analytical skills among students. Several initiatives and pilot projects have helped identify key best practices for integrating research competencies into a nuclear curriculum. These include:

- Interdisciplinary collaboration between different academic departments and research groups.
- Designing research-focused courses and practical activities.
- Establishing mentoring opportunities for students interested in research.

Additionally, the importance of engaging students in research projects from early stages of their training has been highlighted. This allows them to develop research skills and gain an appreciation for scientific inquiry.

Thus, the implementation of a nuclear curriculum with research competencies represents a significant step towards a comprehensive and forward-looking professional education. While

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there are challenges in implementation, previous experiences have provided valuable lessons and underscored the importance of continuing to explore innovative ways to integrate research into professional training.

3.1. Characterization of National Scientific Production on the Nuclear Curriculum.

*After exhaustive searches in scientific repositories, using Google's search engine, a meticulous review of various indexed journals from Latindex and Scopus databases was conducted. This rigorous process enabled the collection of a kno*wledge corpus spanning from 1996 to 2021, carefully identifying and selecting a total of 8 relevant articles on the topic of the nuclear curriculum.

For the characterization of scientific production, the categories detailed in *Table 2* were established.

Table 2

Categories of Scientific Production on the Nuclear Curriculum.

Analysis Categories	f	%
Concept of the nuclear curriculum	2	25.00%
Nuclear curriculum and medical education	5	62.50%
Nuclear curriculum and science education	1	12.50%
Production 1996 – 2021	8	100.00%

Note: Results from a Google Scholar search using the term "nuclear curriculum"..

3.1.1. Concept of the Nuclear Curriculum in Medical Education.

The concept of the "nuclear curriculum" in medical education focuses on the inclusion of essential competencies for medical practice (Marcondes, 1996). This approach seeks to ensure that all students acquire fundamental skills and knowledge necessary to practice medicine competently. By implementing a nuclear curriculum, students develop a solid foundation in critical areas of medicine, allowing them to acquire the necessary skills for clinical practice and standardizing learning experiences for all students.

The proposed nuclear curriculum system aims to ensure a balanced learning experience of core content while allowing students to supplement their learning based on their interests. Additionally, it seeks to establish an effective teaching and learning process for comprehensive medical training, incorporating new medical content and technological advancements. This is achieved by promoting interdepartmental integration and flexibility in incorporating materials, as well as offering additional courses and practical experiences.

Regarding the suggested administrative structure, the Congregation and the leadership of the school director play a key role in the process. The formation of a Curriculum Analysis Council, composed of faculty members and students, is proposed, along with the creation of task forces

with specific functions. These task forces contribute proposals and solutions to continuously improve the curriculum system. Furthermore, the nuclear curriculum can help ensure coherence and consistency in medical training by establishing a core set of objectives and competencies that all training programs must address (Palés, 2006).

In medical education, determining the core curriculum in basic sciences follows specific criteria. These include the relevance of topics for clinical understanding and application, as well as their recurrence in fundamental medical problems. The inclusion of these contents is considered essential for competent medical training, while topics not included in the core curriculum may be offered as optional modules. The depth at which these topics are covered is also defined to establish the evaluable aspects of the curriculum (Martínez, 2006).

In the curriculum update for specialized fields such as Diagnostic and Therapeutic Imaging, the role of a dedicated commission composed of faculty members and graduates is highlighted. This commission is responsible for contextualizing and analyzing the profession. The process begins with the identification of relevant professional practices to ensure the relevance of the study plan's content (Solís et al., 2019). In clinical communication, the Basic Curriculum Subgroup of the Teaching Committee has developed a consensus for a nuclear curriculum in clinical communication competencies, based on HPCCC teaching-learning objectives adapted to linguistic and cultural contexts (Ahn & Bomback, 2020).

Additionally, there is a growing integration of artificial intelligence into the medical physics curriculum and practice, highlighting its benefits in data management, clinical support, medical image analysis, and workload reduction. This integration aligns with technological and industrial trends, preparing professionals to tackle the challenges of modern healthcare (Zanca et al., 2021).

3.1.2. Nuclear Curriculum and Science Education.

The category of work emerges as a crucial organizing principle in science curriculum development. Recognizing it as a human and intentional activity aimed at transforming both the environment and human beings, this approach seeks to promote a comprehensive and emancipatory education. By adopting work as a central theme, the curriculum can be designed to foster critical analysis of the interactions between science, technology, society, and nature, enabling a broader and more reflective understanding of scientific disciplines (Moreira Siqueira & Fortuna, 2022).

The inclusion of work as an organizing principle also considers the historical nature of knowledge and its relationship with social practice. This allows for contextualization within historical and social timeframes and clarifies the ethical, political, and environmental implications of its application.

Additionally, concerns have been raised about trends adopted in the National Common Curricular Base for Secondary Education, reflecting a neoliberal orientation. This orientation favors a utilitarian approach to education, undermining the goal of an emancipatory education. The discrepancy between Secondary Education Reform and the BNCC, along with the influence of different interest groups in its formulation, may jeopardize the pursuit of a comprehensive education. This, in

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turn, may contribute to maintaining bourgeois control over the Brazilian educational system and perpetuating social inequalities.

3.2. Characterization of Scientific Production on Research Competencies.

To conduct the characterization of scientific production related to research competencies, the categories detailed in *Table 3* have been developed. These categories were formulated based on an analysis of 26 articles published in various databases accessible through Google Scholar.

The inclusion criteria covered studies published in both regional journals and high-impact journals.

Table 3

Categories of Scientific Production on Research Competencies.

Analysis Categories	f	%
Approaches to developing research competencies	3	11.54%
Training in research competencies	9	34.62%
Instruments for evaluating research competencies	4	15.38%
Research competencies of faculty members	4	15.38%
Research competencies in students	6	23.08%
Production 2019 – 2024	26	100.00%

Note: Results from a Google Scholar search using the term “research competencies”.

3.2.1. Approaches to Developing Research Competencies.

The characterization of approaches to addressing research competency in the university setting is based on various studies that have explored this topic from different perspectives.

First, a study conducted at Universidad de Los Andes focused on university faculty members from various fields to record, analyze, and interpret attitudinal research competencies (Fontanilla & Mercado, 2020). This descriptive-analytical approach provides a comprehensive view of the research competencies present in university faculty members.

Another approach was the didactic model proposed for pedagogy students, which focuses on socioformation and the development of research competencies (Ceballos, 2020). This perspective sought to turn students into education researchers, fostering the collaborative development of research projects and the application of intervention strategies. Additionally, the use of evaluation instruments to measure the impact of these competencies on students was highlighted, demonstrating a practical and results-oriented approach.

Moreover, deficiencies in integrating Information and Communication Technologies (ICTs) in university teaching have been identified, which negatively impact scientific production. A lack of

training and professional development in the pedagogical use of ICTs limits the application of innovative teaching strategies and the use of technological tools to promote research among university faculty members (Tusta, 2021).

In this context, recommendations to improve research competencies in university teaching include:

- Promoting ICT training programs within educational institutions.
- Encouraging collaborative networks among faculty members to share knowledge and experiences.
- Strategically and systematically integrating ICTs into academic training, which will enhance teaching quality and promote scientific production in universities.

The approaches to addressing research competencies in higher education range from evaluating and analyzing existing competencies among faculty to implementing teaching strategies focused on researcher training. However, it is crucial to address gaps in ICT integration to foster a more research-conducive university environment and enhance scientific production.

3.2.2. Training in Research Competencies.

The training of research competencies in higher education is based on the integration of cognitive dimensions, knowledge, skills, personal qualities, attitudes, abilities, and metacognitive aspects, enabling students to successfully engage in research activities. This complex approach introduces a new conception of research competency development, addressing it from the epistemology of complexity and promoting the integration of various elements (Reiban et al., 2017).

Universities have implemented various strategies to enhance research competency training, including:

- Research incubators
- Project-based learning
- Teaching-learning approaches that incorporate technology

For example, a study by Parra (2017) demonstrated the effectiveness of mobile learning with apps in fostering research skills. Furthermore, a shift toward a competency-based teaching model has been emphasized, which also requires a review of assessment strategies.

The microcurriculum approach has been identified as a means to develop research competencies, incorporating pedagogical strategies that directly impact academic activities related to research (Girón, 2021). This requires faculty responsible for designing microcurricula to have:

- Expertise in competency-based teaching methods
- Strong research methodology skills

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- First-hand research experience
- Qualities and attitudes that enhance research training

Acquiring and developing research competencies in university students is considered crucial for:

- Meeting the demands of the current and future job market
- Fostering innovation and business competitiveness (Hernández et al., 2021)

To achieve this, pedagogical strategies based on cooperative learning and research competency development within professional training programs have been proposed, emphasizing a more practical and participatory learning approach.

The growing access to ICTs among university faculty presents new opportunities to:

- Improve research in higher education
- Facilitate knowledge access
- Promote innovation in teaching
- Increase faculty motivation to stay up-to-date in research-related topics

However, despite greater accessibility to ICTs, there are still gaps and inconsistencies in their use by university faculty members, including:

- Lack of proper training
- Difficulties integrating ICTs into research processes
- Absence of standardization
- Limited access to advanced research tools

These challenges highlight the need to address barriers to effectively using ICTs in research and developing research competencies (Moreira Moreira et al., 2021).

The training of research competencies in higher education is fundamental to preparing students for the challenges of the professional world and contributing to social and economic development. Achieving this requires:

- Innovative pedagogical strategies
- Integration of technology
- A practical and participatory approach to learning
- Overcoming barriers to the effective use of ICTs in research

(Cárdenas et al., 2021; Carlín et al., 2020; Chávez Barquero et al., 2016; Chávez Vera et al., 2022).

3.2.3. Evaluation of Research Competencies

The evaluation of research competencies in higher education can be characterized by considering basic, complementary, and advanced competencies that both faculty and students must possess. These competencies encompass a broad spectrum of skills, knowledge, and attitudes necessary for effective research engagement. Based on the reviewed articles, the evaluation of research competencies is characterized as follows:

1. Basic Research Competencies: The evaluation of these competencies focuses on assessing the acquisition of fundamental scientific research knowledge, the ability to collect, analyze, and synthesize relevant information, as well as the skill to formulate pertinent research questions and apply appropriate research methods. Assessment methods may include written exams, analysis of student- or faculty-conducted research projects, and participation in simulated or real research activities.
2. Complementary Research Competencies: The evaluation of these competencies aims to determine the ability to effectively communicate research findings, both in specialized media and at academic conferences and events. Evaluation rubrics can be used to analyze clarity, coherence, and relevance in communicating research results. Additionally, the ability to disseminate findings in appropriate formats for different audiences can be assessed.
3. Advanced Research Competencies: The evaluation of these competencies involves verifying the ability to work in multidisciplinary teams, lead research projects, develop innovative proposals, and manage resources for project execution. This evaluation may include the review of research projects led by students or faculty as well as participation in simulated or real project management activities (Maldonado et al., 2007).
4. Self-Perception and Motivation: The self-perception of faculty and students as researchers can also be evaluated through surveys or interviews that explore motivation, commitment, and perception of research skills. These assessments provide valuable insights into individuals' willingness to develop research competencies and their influence on the teaching and learning process (Quezada et al., 2020).
5. Validation of Evaluation Instruments: The validation of evaluation instruments, such as questionnaires or rubrics, is crucial to ensuring reliability and validity in the results obtained. This evaluation may include expert review and pilot testing of instruments to verify their effectiveness and relevance in measuring research competencies (Rodríguez et al., 2020).

The evaluation of research competencies in higher education requires a combination of methods and tools to verify the acquisition and development of research-related skills, knowledge, and attitudes. Additionally, it is important to consider individuals' self-perception and to validate evaluation instruments to ensure the reliability and accuracy of the obtained results (Ponce et al., 2020).

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3.2.4. Research Competencies of Faculty Members

The research competency of faculty members is characterized by its comprehensive development through socioformation, which aims to cultivate both cognitive and affective-behavioral aspects necessary to address the challenges of the knowledge society. Socioformation fosters collaborative work, contextual problem-solving, and an ethic of continuous improvement. In this regard, the faculty research competency focuses on equipping educators to identify, interpret, argue, and solve problems ethically and efficiently, thereby contributing to sustainable social development (Barón, 2020).

The proposed research competencies can be implemented in education through various pedagogical strategies, such as:

6. Promoting Research in the Classroom: Faculty members can encourage research among students by guiding them to identify and solve relevant contextual problems using different methods and approaches.
7. Developing Formative Projects: Formative projects, as part of socioformative methodology, allow students to develop research competencies by addressing real-world problems, interpreting data, and arguing conclusions.
8. Collaborative Work: Encouraging teamwork as a key research competency enables knowledge and skills sharing to address problems more effectively.
9. Critical Reflection: Promoting students' ability to critically analyze information, evaluate different research approaches, and reflect on their own research process (Aliaga & Luna, 2020).

The validation of these competencies was conducted through confirmatory factor analysis, which demonstrated a high correlation between competencies and their associated actions. This analysis validated the conceptual structure of proposed research competencies and established their relationship with specific actions that characterize them (Moscoso & Carpio, 2022).

In the current academic context, higher education researchers face challenges that require constant updating of their competencies as well as institutional adaptations to meet the changing demands of society and academia. This includes the need to:

- Address new economic, educational, and cultural challenges.
- Incorporate knowledge society dynamics.
- Adapt to 21st-century educational demands (Yangali et al., 2020).

The analysis of faculty research competency revealed that attitudinal competency was the highest-rated, suggesting a strong willingness among faculty members to engage in research. Furthermore, the importance of methodological training and faculty research capacity is emphasized, as these are critical for effectively guiding students in the development of research competencies from early stages of education.

The promotion of a research culture and the strengthening of faculty research competencies can be achieved through comprehensive training programs, collaborative work, and critical reflection, contributing to high-quality education and research advancement in academia.

3.2.5. Research Competencies in Students.

Research competency in students is characterized by developing cognitive and behavioral skills that enable them to conduct rigorous and effective research (Juárez & Torres, 2022). According to the study, university students reported having developed competencies such as:

- Theoretical contrast skills
- Scientific writing
- Mastery of citation and referencing norms

Additionally, other key competencies mentioned include observation, reading, expression, creativity, rigor, socialization, construction, strategy, problematization, and ethics (Ayala, 2020).

Participation in research incubators significantly contributes to developing these higher-order cognitive skills in students. These competencies not only serve as a cognitive bridge for meaningful learning but also prepare students to:

- Face sociocultural, economic, and political challenges.
- Foster personal and social development (Hernández et al., 2021).

The implementation of specific teaching strategies, such as project-based learning in the classroom or allowing students to choose real-world problems to investigate, has a direct impact on developing basic research competencies.

Results indicate that students achieved high levels of performance in aspects such as autonomy and strategy, while areas like socialization and access to research resources still have room for improvement (Gómez et al., 2019).

In graduate programs, these competencies become even more relevant, as they enable students to conduct scientific research rigorously and contribute to advancing knowledge in their respective fields. Additionally, promoting a research culture and ensuring open access to nonprofit academic education are key factors driving the development of these competencies (Zambrano & Chacón, 2021).

The development of research competencies in university students is essential for their comprehensive education and their contribution to knowledge advancement in various disciplines. Implementing effective teaching strategies and fostering a research culture are critical for enhancing these skills and promoting meaningful and lasting learning experiences.

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3.2.6. Integration of Research Competencies into a Nuclear Curriculum

The integration of research competencies within a nuclear curriculum involves a structured approach to ensure that students acquire fundamental research skills in addition to the essential knowledge of their discipline. This process begins with the identification of key research competencies that should be developed at all stages of professional training, regardless of the student's specialization. These competencies may include critical thinking, the ability to formulate research questions, mastery of appropriate methodologies, and data interpretation.

To implement these competencies within a nuclear curriculum, a curriculum design is required that promotes research from the early stages of education. This can be achieved through:

- Specialized courses on research methodology
- Research projects integrated into the curriculum
- Practical activities that encourage the application of research knowledge

Additionally, it is essential to establish a mentorship system in which students collaborate with experienced faculty members and researchers, allowing them to participate in real research projects and apply their research skills in practical contexts.

Furthermore, interdisciplinarity plays a key role in this process, as it enables students to collaborate across different fields of knowledge, enriching their research training. Continuous assessment of these competencies should be incorporated, using evaluation tools that measure not only technical proficiency in research but also problem-solving abilities, creativity, and project management skills.

The integration of Information and Communication Technologies (ICTs) in the development of these competencies is another critical factor. The use of digital tools for information retrieval, data analysis, and online collaboration facilitates the incorporation of research into teaching and prepares students for the challenges of the academic and professional environment.

Thus, a nuclear curriculum with integrated research competencies not only prepares students to become competent professionals but also equips them to actively contribute to knowledge advancement.

Conclusions

The implementation of a core curriculum that incorporates research competencies in professional training emerges as a fundamental pillar. This not only ensures that students acquire essential skills to competently perform in their respective fields but also fosters the development of crucial research capabilities in disciplines such as health and other areas. It is important to recognize that there are various approaches and practices to integrate these competencies into the core curriculum. Interdisciplinary collaboration, the design of research-focused courses, and early mentorship in research projects are examples of strategies that nurture students' critical and analytical thinking.

The assessment of research competencies covers a broad spectrum, from verifying fundamental knowledge to evaluating the ability to effectively communicate results, work in multidisciplinary teams, and lead research projects. This process requires the use of appropriate assessment methods and tools to measure progress and goal achievement. It is crucial to understand that the development of research competencies is not limited to students. It also involves fostering these capabilities in faculty members, promoting a research culture within the educational environment, and contributing to knowledge advancement and innovation.

Lastly, the effective integration of information and communication technologies (ICT) in research training and practice plays a vital role. This not only enhances the quality of education but also drives scientific production and prepares professionals to face evolving challenges in their fields of study. This study highlighted the importance of implementing a core curriculum that integrates research competencies in professional training, as well as the need for effective strategies to develop and assess these skills in both students and faculty.

One of the main limitations of the study was the lack of diversity in information sources, as most of the reviewed articles came from databases such as Google Scholar. This may have limited the inclusion of relevant studies that are not indexed on this platform. Additionally, the review focused on publications in Spanish and English, excluding articles in other languages, which might have restricted the scope of the findings. Furthermore, the study's focus on literature published up to 2022 may have excluded more recent research that offers new approaches or practices regarding the core curriculum and research competencies.

Another significant limitation was the concentration of studies in specific areas such as medicine and sciences, leaving a gap regarding documented experiences in other disciplines. The lack of experiences in fields outside the medical and scientific domains may have constrained the development of a proposal that encompasses a broader variety of educational contexts. Moreover, the implementation of the strategies suggested in this study has not yet been extensively tested in the Ecuadorian context, leaving room for unforeseen challenges in applying these recommendations.

Despite these limitations, the study's results offered valuable practical implications. Implementing a core curriculum that integrates research competencies in education can promote a more structured and coherent approach to training students and faculty, enhancing their ability to generate and apply knowledge critically and methodically. The inclusion of research competencies fosters critical thinking and problem-solving, key skills in today's professional world, especially in fields where research is essential for knowledge advancement.

Additionally, promoting interdisciplinary collaboration and the use of technology in teaching and research can enrich the educational experience and prepare students for the challenges of the 21st century. The study suggested that engaging students in research projects from early stages is an effective strategy for developing research competencies, which could be replicated at different educational levels. Finally, universities and educational institutions in Ecuador could benefit from adopting these strategies not only to improve the quality of education but also to contribute to the growth of a strong and sustained research culture in the country.

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