

Original article

## System of actions for the development of research skills in medical students



### Sistema de acciones para el desarrollo de las habilidades investigativas en los estudiantes de Medicina

### Sistema de ações para o desenvolvimento de habilidades de pesquisa em estudantes de Medicina

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## ABSTRACT

The way in which universities train their future researchers determines their long-term professional retention and contributes to increasing a country's scientific potential. This study aims to propose a system of actions that integrates curricular and extracurricular activities for the development of research skills in medical students, responding to the demands of a society that requires high standards of research and clinical practice. A pedagogical research study was conducted at the Dr. José Assef Yara Faculty of Medical Sciences in Ciego de Ávila, Cuba, between January 2023 and June 2024. Theoretical methods (analytical-synthetic, historical-logical, inductive-deductive, systemic-structural-functional, and hypothetical-deductive) and empirical methods (observation, document analysis, surveys, focus groups, and expert consultation) were applied, complemented by statistical analyses (Cronbach's alpha coefficient and Kendall's concordance coefficient). The results revealed

deficiencies in current research training, and the relevance and feasibility of the proposed system were confirmed using the nominal group technique. It is concluded that the systematic integration of curricular and extracurricular activities, along with teacher training, is essential to enhance the research capacity of future physicians.

**Keywords:** curriculum; medical education; research skills; formative research; action system.

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## RESUMEN

La manera en que la universidad forma a sus futuros investigadores determina su permanencia profesional a largo plazo y contribuye a incrementar el potencial científico de un país. El presente trabajo tiene como objetivo proponer un sistema de acciones que articule lo curricular y lo extracurricular para el desarrollo de las habilidades investigativas en los estudiantes de Medicina, respondiendo a las demandas de una sociedad que exige altos estándares de investigación y práctica clínica. Se realizó una investigación pedagógica en la Facultad de Ciencias Médicas Dr. José Assef Yara de Ciego de Ávila, Cuba, en el período correspondiente a enero 2023 y junio 2024. Se aplicaron métodos teóricos (analítico-sintético, histórico-lógico, inductivo-deductivo, sistémico-estructural-funcional e hipotético-deductivo) y empíricos (observación, análisis documental, encuestas, grupos de discusión y consulta a expertos), complementados con análisis estadísticos (coeficiente Alfa de Cronbach y coeficiente de concordancia de Kendall). Los resultados evidenciaron deficiencias en la formación investigativa actual y, mediante el empleo de la técnica del grupo nominal, se confirmó la pertinencia y factibilidad del sistema propuesto. Se concluye que la integración sistemática de actividades curriculares y extracurriculares, junto con la capacitación docente, es esencial para potenciar la capacidad investigativa del futuro médico.

**Palabras clave:** currículo; formación médica; habilidades investigativas; investigación formativa; sistema de acciones.

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## RESUMO

A forma como as universidades preparam seus futuros pesquisadores determina sua permanência profissional a longo prazo e contribui para o aumento do potencial científico de um país. Este artigo tem como objetivo propor um sistema de ações que integre atividades curriculares e

extracurriculares para o desenvolvimento de habilidades de pesquisa em estudantes de Medicina, respondendo às demandas de uma sociedade que exige altos padrões de pesquisa e prática clínica. Um estudo pedagógico foi conduzido na Faculdade de Ciências Médicas Dr. José Assef Yara, em Ciego de Ávila, Cuba, entre janeiro de 2023 e junho de 2024. Métodos teóricos (analítico-sintético, histórico-lógico, indutivo-dedutivo, sistêmico-estrutural-funcional e hipotético-dedutivo) e empíricos (observação, análise documental, questionários, grupos focais e consulta a especialistas) foram aplicados, complementados por análises estatísticas (coeficiente alfa de Cronbach e coeficiente de concordância de Kendall). Os resultados revelaram deficiências na formação atual em pesquisa, e a relevância e viabilidade do sistema proposto foram confirmadas utilizando a técnica de grupo nominal. Conclui-se que a integração sistemática de atividades curriculares e extracurriculares, juntamente com a formação de professores, é essencial para aprimorar a capacidade de pesquisa dos futuros médicos.

**Palavras-chave:** currículo; formação médica; habilidades de pesquisa; pesquisa formativa; sistema de ações.

## INTRODUCTION

The way in which universities train their future researchers determines their long-term professional tenure and contributes to increasing a country's scientific potential. Introducing students to research from the beginning of their undergraduate studies instills enthusiasm for this activity and promotes improvements in their individual and collective performance, with increases in academic achievement, advancements in their perception of personal and academic efficacy, as well as incentives to pursue postgraduate studies that qualify them as researchers (Vergara-Barra *et al.*, 2019).

Scientific research, with its own inherent logic, can be considered the highest expression of the skill that students must master in any type of educational process. Therefore, student scientific activity should become a key driving force in the scientific, technical, and comprehensive training of medical students.

University excellence in Cuba requires that professional training be comprehensively integrated between teaching and research. The president has emphasized the importance of science,

technology, and innovation for social transformation (Díaz-Canel Bermúdez *et al.*, 2020). Strategic guidelines for Higher Education have highlighted the role of research as a cross-cutting axis in medical training, promoting the integration of research content at the undergraduate level (Gutiérrez Rojas, 2021).

In the current context of medical education, deficiencies can be observed that affect the comprehensive development of students' research skills. These include: a disconnect between curricular and extracurricular activities, fragmented planning of research activities, and a lack of systematic mechanisms for continuous feedback. Faced with this problem, it is necessary to propose renewed approaches that not only acknowledge existing gaps but also structure a coherent and evaluable training process.

Recent observations suggest that, despite the inclusion of research aspects in the curriculum E of the medical degree program, shortcomings may arise in the systematic integration of this content and in its connection with extracurricular activities (Purón Prieto *et al.*, 2022). Problems with literature searches, methodological deficiencies, and low participation in scientific projects and events are also possible, all of which call for a rethinking of the research training process.

The present work aims to propose a system of actions that articulates the curricular and extracurricular aspects for the development of research skills in medical students, positively influencing their comprehensive training and their future contribution to public health.

## **MATERIALS AND METHODS**

A pedagogical investigation was carried out at the Dr. José Assef Yara Faculty of Medical Sciences in Ciego de Ávila, during the period from January 2023 to June 2024. The dialectical-materialist approach was adopted as the general conceptual framework.

The theoretical methods fostered systematicity and logic in the scientific research process: analytical-synthetic, for the analysis and synthesis of the literature and the elaboration of the diagnosis; historical-logical, to identify trends in research training in Medicine; inductive-deductive, with the intention of structuring the information and defining the necessary research skills; systemic-structural-functional, to design the system of actions and hierarchically order the actions; hypothetical-deductive, to formulate assumptions and evaluate the viability of the system.

Among the empirical methods applied were: scientific observation, conducted using structured guides to evaluate research activities in students; and surveys, administered to 30 students, 12 graduates, and 15 professors, to understand their perceptions of research training. The survey of students and graduates from the province of Ciego de Ávila was used to identify the level of theoretical and methodological preparation demonstrated by newly graduated general practitioners at the start of their professional practice, as well as the research preparation of medical students. The survey of professors allowed for characterizing the faculty's preparedness to incorporate research topics into their courses and understanding the importance they placed on research training for medical students. Documentary analysis of regulations, curricula, course syllabus, and research papers were also employed. Documentary analysis revealed the treatment given to scientific research in the current study plan (Plan E), its level of representation and position as content in the program of the discipline Research Methodology in Health, and its interdisciplinary relationship with the subjects of General Medicine as the Main Integrative Discipline.

The nominal group technique was used in the expert consultation, allowing for adjustments to the proposed action plan. Its implementation was structured as a face-to-face meeting with 12 participants to achieve a precise and reliable practical result, thereby verifying the fulfillment of the research objective. This was an important element in evaluating the proposed action plan, as it revealed the level of acceptance and appreciation of this group of experts with experience in teaching and research, particularly in the area of developing research skills in medical students.

The study complied with the Second Declaration of Helsinki and Cuban ethical regulations. The data obtained, the surveys administered, and the opinions expressed by the participants were protected under the principle of confidentiality. Participants signed informed consent forms to collaborate in the research and agreed to the publication of the results with the guarantee of their anonymity.

A percentage analysis of the collected data was performed. Additionally, Cronbach's alpha coefficient was used to assess the reliability of the questionnaires, and Kendall's coefficient of concordance was used to measure the consistency of the experts' responses.

## RESULTS

Documentary analysis showed that, although the study plan E of the career under study includes the investigative function in the professional model, the methodological guidelines and the links with extracurricular scientific activity are insufficient.

It was identified that the overall objective of the curriculum strategy for research and medical informatics, and the objectives of the subjects Research Methodology in the first year and Biostatistics in the second year, are adequately aligned with preparing students to develop their research skills. However, the methodological guidance provided to professors to achieve these objectives within the dynamics of the educational process is insufficient, and the necessary links with student scientific activity as an extracurricular expression are not evident.

In the General Medicine curriculum, research methodology content was identified in only two courses: Introduction to Comprehensive General Medicine in the first semester and Public Health in the ninth semester. In the former, the content relates to science and scientific knowledge, specifically in Thematic Unit II, which includes methodological guidelines for students to conduct a literature review in pairs and trios on a healthy lifestyle or a disease risk factor as a form of partial assessment. In the latter, the content relates only to the types of epidemiological research, their methodological characteristics, and research ethics.

Deficiencies were also identified in conducting literature searches, in the methodological execution of research, and in communicating scientific results. Based on these findings, a phased system of actions was structured for developing research skills in medical students. This system, which unfolds over the five years of their studies, includes coordination meetings, thematic workshops, seminars, publication workshops, and continuous evaluations at three levels: reactive, immediate (scientometric), and proactive (long-term).

The following requirements were considered in the selection of experts: membership as a faculty member in the Medical School, membership in the program's methodological team, expertise in the disciplines of Research Methodology and General Medicine, and coordination of the computer science curriculum strategy at the University of Medical Sciences of Ciego de Ávila. More than 10 years of experience in teaching and research within the health sector, with a direct connection to Medical Education and, specifically, to the research topic; publications addressing the topic in some way, as

well as academic and teaching rank. Furthermore, a distinguished reputation as a specialist in the health sector, demonstrated by their professional training and performance as a faculty member at the medical university.

The initial sample consisted of 12 potential experts. Of these, three held doctorates in Educational Sciences, eight held master's degrees, and five held second-level specialist qualifications. Based on their teaching rank, three were full professors, eight were associate professors, and one was an assistant professor. Based on their academic rank, one was a full researcher, three were assistant researchers, three were associate researchers, and three were research fellows. All 12 had more than 10 years of experience in training general practitioners; four even had more than 20 years of experience.

Next, the competence coefficient of the selected experts was determined by applying a survey, where a self-assessment was proposed on a scale of 1 to 10 in ascending order, depending on the degree of knowledge they possessed on the investigated topic, in addition to the degree of influence of the sources of argumentation on their assessments.

The competence of the experts was determined by the K coefficient, calculated from the expert's own rating on a scale of 0 to 10, multiplied by 0.1.

High and medium levels of competence were considered expert. In this case, the results showed that of the 12 respondents, 11 possessed a high level of competence, while one had a medium level of competence.

Two rounds were carried out, as in the second one a definition of agreements was reached and a stability in the responses issued by the experts when compiling their criteria on the system of actions.

All indicators reached evaluation percentages between Very Adequate and Quite Adequate, which are between 70% and 90% and this guarantees a high reliability on the quality in the preparation of the system of actions and the possibilities of its application, based on the approval by the experts of the theoretical and methodological foundations that support the system of actions, as well as the quality of the results of the diagnosis and the selection of the contents for the development of investigative skills in the students of the Medical career.

Kendall's coefficient of agreement was high: 1.000, with statistically significant results ( $p=0.000$ ). Therefore, it can be stated that there is agreement among the experts when evaluating the results of the seven aspects of the System of Actions for the Development of Research Skills in Medical Students (Table 1).

**Table 1.** Contrast statistics

N	12
W of Kendall <sup>a</sup>	1,000
Chi-square	60,000
GI	5
Sig. asyntót.	,000

a. Kendall's coefficient of concordance

The reliability level of the questionnaire directed to the expert judges, determined through the Cronbach's Alpha statistical test, yielded an overall level of 0.923 (Table 2).

**Table 2.** Reliability level of the questionnaire

Cronbach's alpha	Number of elements
,923	12

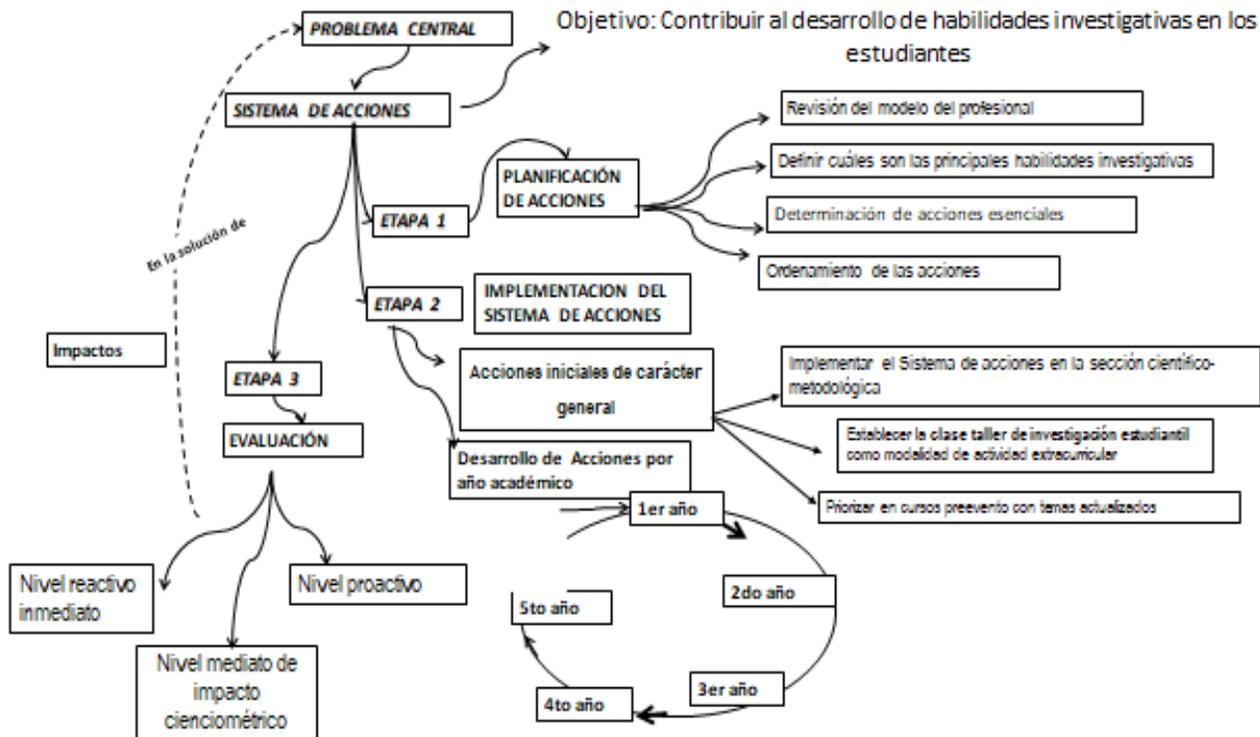
This coefficient demonstrates the internal consistency of the instrument and guarantees the stability of the results obtained by expert judgment.

Other statistical techniques were applied to evaluate the action system (absolute frequency, cumulative absolute frequency, cumulative relative frequency, and cut-off points). All techniques showed that highly appropriate results prevailed in the experts' responses, thus validating the action system.

The system of actions for developing research skills in medical students presented here stands as an innovative methodological proposal for strengthening research skills in future physicians. This system is organized into three fundamental stages:

- Stage 1. Preparatory (planning and organization). This stage begins with a critical review of the professional model and curriculum, identifying current shortcomings and defining essential actions. A hierarchical order is established for the activities, which will be integrated throughout the different curricular levels, progressing from simple to complex.
- Stage 2. Implementation. This phase involves carrying out general and specific actions. The general actions include defining the research problem within the methodological plan, interdepartmental coordination, and disseminating information about the activities through institutional channels. The specific actions are tailored to each year of the program and incorporate:
  - Initial meetings for the organization of research teams.
  - Workshop classes focused on key topics such as: methodology, literature review, scientific communication and analysis of the health situation.
  - Extracurricular activities, such as dissertation seminars, scientific publication workshops, and participation in events that allow for the socialization and discussion of results.
- Stage 3. Evaluation. A comprehensive evaluation system is planned, encompassing three levels:
  - Immediate feedback: measuring student satisfaction after each activity using assessment instruments.
  - Mediate: evaluation of the scientometric impact through indicators such as participation in projects, presentations and publications.
  - Proactive long-term: monitoring the professional performance of graduates, considering aspects such as the quality of the thesis, continuity in postgraduate studies and insertion in scientific management areas.

This system, by continuously articulating planning, execution and evaluation, allows for didactic adjustments based on the results obtained, contributing to a more robust research training adapted to the contemporary needs of the medical profession (Figure 1).



**Figure 1.** Graphic representation of the system of actions for the development of investigative skills in medical students

The new educational approaches stem from the recognition that research must be organically integrated at all levels of the degree program. To this end, a synergy between mandatory academic activities and extracurricular initiatives is proposed. The participation of professors, assuming tutoring and guidance roles in research activities, is essential to overcome the fragmentation and lack of systematicity observed in traditional educational processes.

Furthermore, the incorporation of the System of Actions for the Development of Research Skills in Medical Students responds to the need to structure an upward and progressive path in the development of research competencies. From the first year, students are encouraged to become familiar with the methodology and information retrieval, progressing toward practical application in projects, report writing, and, finally, participation in spaces for disseminating and evaluating scientific results. This approach not only reinforces the acquisition of theoretical knowledge but also fosters critical thinking, creativity, and autonomy in solving health problems.

Integrating the System of Actions into the research training of medical students represents an innovative and necessary strategy to address current shortcomings in the educational process. By establishing a structured system that encompasses everything from planning and organization to continuous evaluation, a more coherent, dynamic, and scientifically excellence-oriented education is guaranteed. In this way, the aim is to prepare professionals capable of meeting the challenges of contemporary healthcare, promoting a robust research culture that contributes to scientific advancement and improves the population's quality of life.

## DISCUSSION

The path to university excellence lies fundamentally in the teaching-learning process and the process of scientific research. In higher education, the latter has a dual function: it contributes to the professional training of students and is also a means of solving complex problems that arise in society. Scientific research prepares students to embark on the logical paths of scientific thought, essential for the development of cognitive abilities, especially creative ones, through which they acquire concepts, laws, and theories that allow them to delve into the essence of phenomena with the help of the scientific method. Consequently, to raise the quality of the educational process, professors must become active researchers both inside and outside the classroom; therefore, they must possess a productive scientific attitude in their work (Mendoza Bequer *et al.*, 2023).

The research training process in the Medicine career, as well as the main aspects related to its didactics, are fundamentally based on the approaches of Marañón Cardonne *et al.* (2018) and Gutiérrez Rojas (2021).

The construction of new scientific knowledge about human health, as a conscious and committed process, unfolds through the processes of nature, society, and thought. The discipline of Health Research Methodology focuses on developing students' scientific thinking as part of their professional practice, providing them with the scientific methodology and tools for its application in solving scientific problems they will encounter throughout their studies and their lives as physicians.

In this sense, Lorences (2009) refers to a system having practical significance when the researcher proposes tools (means, actions, logical steps, exercises, teaching tasks) to facilitate pedagogical practice (teaching, educational, and methodological) and systematically organizes them based on

specific theoretical or empirical criteria. This concept is adopted for the purposes of this research, as it is considered the closest to the objective being pursued.

To substantiate the proposed system of actions, certain theoretical and methodological references are assumed:

- The general systems theory and the systemic approach in scientific research, being an expression of its logical order, recursion and interrelation that is established between the subsystems and components that form it; given by the procedures, objectives and specific actions in each of them, where in turn relationships of hierarchy and subordination are established between them (de la Peña Consuegra & Velázquez Ávila, 2018).
- The necessary integration between teaching, attention and research for the preparation of the medical student, based on their future performance in the medical-professional context (Valcárcel Izquierdo *et al.*, 2019).
- The interdisciplinary conceptions of Rosell Puig *et al.* (2002), which, in the complex medical teaching and care setting, necessitate an integrative approach to solving professional problems, are coherent and integrated with the theoretical and practical foundations of the different disciplines. In this way, they can achieve the appropriation of new knowledge and the acquisition and development of new research skills.
- The importance of employing active learning methods that promote independent student activity enhances student management of their own learning and the possibility of making critical judgments that may or may not coincide with those of the teacher. In this way, the student takes on a more active role and acts under the guidance and orientation of the teacher. In this sense, problem-based learning methods are considered important, as they offer ample opportunities for achieving creative levels within the educational process by harmonizing the reproductive with the productive as the foundation upon which creativity rests, as Fuentes (2009) states.
- The conception of student scientific activity, as noted García Pérez (2020) In medical education, it constitutes part of a unique curricular and extracurricular training process, beginning curricularly in the disciplines of Research Methodology in Health and General Medicine, for the development of research skills.
- The curricular-extracurricular integration mediated by student scientific activity, as cited by the last author, on research with student research groups in which he recognizes that research

training, as a traditional curricular modality in Cuba and formative research, which is applied in the aforementioned groups, can complement each other.

- The curricular planning of the disciplines for research training. The coordination from the methodological collective of General Medicine as the main integrating discipline of the career is articulated with the discipline of Research Methodology, the curricular strategy Research and Informatics, the institutional research system, the student scientific groups and the lines of research of the institution, harmonized with the contents of the subjects (Barcos Pina *et al.*, 2023; López Espinosa & Álvarez Sintés, 2023; Purón Prieto *et al.*, 2020; 2022).
- The basis for this approach, stemming from Resolution 47/2022 on methodological teaching, defines the training of professionals as occurring both within the curriculum (the teaching and learning process) and in extracurricular activities. Extracurricular scientific research and university outreach, as well as participation in high-impact social projects, are integrated into this training, constituting vital elements for the comprehensive development of students.

The proposed system of actions coherently integrates curricular and extracurricular aspects, addressing the identified deficiencies in research training. Its evaluation, using the nominal group technique, supports its relevance and feasibility, while the proposed evaluation indicators will allow for systematic monitoring of its implementation.

The incorporation of specific workshops, dissertation seminars, and publishing workshops aims to foster students' autonomy, collaboration, and critical thinking skills. However, the need to strengthen teacher training and establish a closer relationship between course activities and extracurricular initiatives is emphasized.

Although the results are preliminary, the data suggest that implementing the system could lead to greater participation in scientific activities, improved research performance, and a stronger research culture within the medical program. The research training of medical students benefits from a comprehensive approach that combines theoretical content with extracurricular activities, promoting autonomy, critical thinking, and collaborative skills.

The proposed system of actions, valued by experts, offers a stepped structure adapted to the different curricular levels, allowing for systematization and continuous evaluation of the development of research skills.

The implementation of this system, along with adequate training and commitment from the teaching staff, is projected as an effective strategy to transform the research culture in the Medicine career, raising both academic performance and the ability to face complex health problems.

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### **Conflict of interest**

Authors declare no conflict of interests.

### **Authors' contribution**

The authors participated in the design and writing of the article, in the search and analysis of the information contained in the consulted bibliography.



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