

Research Article

Formation of Scientific Thinking in Students: Impact of the High Academic Demand Program at the Faculty of Medicine, UNAM

Aurora Farfán Márquez* 

Faculty of Medicine, National Autonomous University of Mexico, Mexico City, Mexico

Abstract

Introduction: Promoting research in undergraduate training is crucial for preparing human resources in the health field. In particular, the Highly Academically Demanding Program (PAEA) of the UNAM School of Medicine has been a pioneer in this initiative. It begins in the fifth semester, when students have acquired basic methodological tools through courses such as research methodology and statistics. **General Objective:** Formation of Clinical professionals with a research-oriented perspective. **Materials and methods:** During five annual events, 408 students were with a principal investigator in their laboratories and/or work locations, participating in their research projects so that at the end of the school year they could present their work. **Results:** 256 research papers were presented in basic, clinical, and sociomedical areas. Two of the conferences were held in person, and three were held virtually due to the SARS-COVID-19 pandemic. This is what the medicine of the future holds for us. **Conclusions:** This type of academic activity has been very positive for both tutors and students, as both receive valuable instruction and feedback, thereby fulfilling the instructors' human resources training and sparking students' interest in research, thereby meeting their expectations. Furthermore, some students have published their work, underscoring the value of this experience for their academic and professional development.

Keywords

Congress, Research, Academic, High Academic Excellence Program, PAEA

1. Introduction

Research, regardless of the discipline, is a fundamental tool for the development of new knowledge, both in scientific innovation and in health. It has been considered a systematizing process based on curiosity and the search for explanations for the different physical, chemical, biological, and social processes that surround us, in order to identify the behavior, composition, and content of the various phenomena that can be explained.

It is essential to bear in mind that research must be systematized in order to minimize the subjectivity and biases that can arise at any time, or at least limit them. To achieve this, it is essential to use the scientific method, comprised of a series of steps and rules that promote objectivity and distance the researcher from the object of study, proposing a comprehensive understanding of the study.

Therefore, the scientific method relies on measurements

*Corresponding author: afarfan@facmed.unam.mx (Aurora Farfán Márquez)

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and specific principles of reasoning. Its tools include various statistical methods, hypothetical-deductive methods, measurement procedures, and others, which provide the necessary instruments to achieve established objectives. This is why we refer to the scientific method as the set of tactics used to construct knowledge, recognizing its susceptibility to human error. Its purpose is to mitigate potential biases that may arise during research. It is not a methodology based on absolute truths, but rather establishes relationships between what is observed and the object of study.

The above is based on two important pillars mentioned by English researcher Bradford Hill. He emphasizes the importance of consistency, that is, replicating the study as many times as necessary to check and verify the data previously obtained through various hypothesis tests. This makes it possible to rule out the initially proposed hypothesis when data differ from what is expected is found.

During the process of applying the scientific method, it is necessary to cultivate curiosity and interest, as well as acquire the necessary tools to do so. For this reason, it is essential to foster in the new generations, regardless of their area of interest, the desire and need to seek answers to the questions that arise daily. These questions are not only the starting point for the creation of new knowledge, but also for personal and professional development.

This purpose has generated various strategies that encourage students to seek and develop knowledge. It provides them with the opportunity to disseminate their work through participation in academic conferences or through publication. These events allow both students and their academic advisors to engage in diverse practices, which are an integral part of sound research. During these meetings, participants present a variety of research projects based on their area of study, sharing experiences and, in most cases, the results of their work. Furthermore, they provide them with the opportunity to interact and learn from the interdisciplinary expertise of experts, acquiring relevant skills for their academic and personal development.

2. Development

The development of comprehensive human resources, including research, is a process supported and planned through the 2010 Curriculum at the UNAM School of Medicine [11]. This plan is based on eight key competencies. Since the beginning of this educational approach, a critical perspective on teaching has been maintained, which has driven the creation of various methods and techniques for collecting and systematizing information with the goal of developing theories [15, 4] (Soriano, 1992. Frías, 2006).

Academic conferences represent enabling environments for the development and application of a wide range of capacities, competencies, skills, abilities, and aptitudes necessary for the academic training process. However, it is important to emphasize that they also take into account the social, personal,

and psychological context of students, as well as their life skills, such as decision-making and resilience. These events offer a platform for the holistic growth of participants, both academically and personally. The incursion of students into research activities has also been documented in other spaces, as proposed by the author Sáez (2024) [14], who points out the outstanding participation of students in a research observatory that allows them to redefine the value of research within their academic training, generating significant learning beyond the traditional curriculum.

It is equally important to highlight the role of the tutor in the academic training process. Their skill in fostering student creativity, originality, and autonomy, along with their ability to guide them without neglecting the rules and foundations of research, are crucial aspects. This reduces deficiencies in methodology, potential errors in the generation and acquisition of knowledge, as well as the lack of follow-up in the training processes [10]. However, we must not forget that research training in the university setting has gained importance as a key strategy for strengthening critical thinking, autonomy, and educational quality. Various studies have shown that attitudes toward research are related to opportunities for early participation in academic projects.

It is important to understand that attending and participating in academic conferences in the field of medicine plays a fundamental role in the development of innovations in this field. These events provide an opportunity to share new discoveries, discuss accumulated knowledge from the perspective of evidence-based medicine, and bring together experts in the field. Furthermore, medical conferences provide an enabling environment for health care professionals to interact and build relationships with their colleagues, which can result in significant career advancement [3].

Likewise, it is important for medical students to cultivate critical thinking and various necessary skills. In 1957, the concept of competencies emerged in the United States, focusing on cognitive work as a tool to evaluate the performance of elementary school teachers. These competencies originated in relation to the performance of professionals who face decisions in complex situations, creatively applying knowledge to each challenge and transferring it to different contexts to solve problems in real-life settings. They are defined as the set of knowledge, skills, attitudes, and values that, when interrelated, enable efficient professional performance. With the aim of integrating this new learning approach, the UNAM School of Medicine, in its 2010 curriculum for the Bachelor of Medicine in Medicine, establishes competencies that students must develop and implement before graduation. These include critical thinking, clinical judgment, decision-making, and information management, as well as self-regulated and lifelong learning and effective communication [11]. According to Saavedra (2015) [13], “research seedbeds” are characterized as multicultural settings that provide conducive and alternative spaces for academic and research discussions among both faculty and students. These environments foster

the development of research skills in both groups through an interdisciplinary approach.

The academic conferences organized for students in the Highly Academically Demanding Program (PAEA) at the Faculty of Medicine aim to provide students with an environment for interaction with experienced speakers and experts in various fields. They also seek to foster the development of skills and abilities relevant to their future professional careers, tailored to their specific areas of interest.

Since its establishment in 1992, one of the main objectives of the Faculty of Medicine's High Academic Excellence Program (PAEA) [8] has been to provide its students with a space to engage in research. Recognizing the importance of developing the skills and abilities of the country's future physicians, the program offers its students the opportunity to participate in an academic conference established by the program it self since 2019. This initiative seeks to strengthen students' academic and scientific training by providing them with a platform for interaction and the exchange of ideas in relevant forums. In the same context, Ángulo Lerma (2022) [1] argues that research incubators constitute an effective curricular approach to fostering scientific interest from the initial stages of training. Specifically, González et al. (2011) [6] argue that the quality of teaching and the type of learning experiences offered by professors significantly affect students' perceptions and research commitment.

Participation in the conference is a requirement for third and fourth year undergraduate students in the program. The process involves students selecting a mentor and obtaining their approval to conduct a research project. They then present evidence of their work through a synthesis, poster design, or other teaching materials that support the presentation of their research progress.

Previous conferences have addressed and analyzed a wide range of topics related to various fields of medicine, which are divided mainly into three sections: basic sciences, clinical sciences, and sociomedical sciences.

The basic sciences constitute the foundation for the gener-

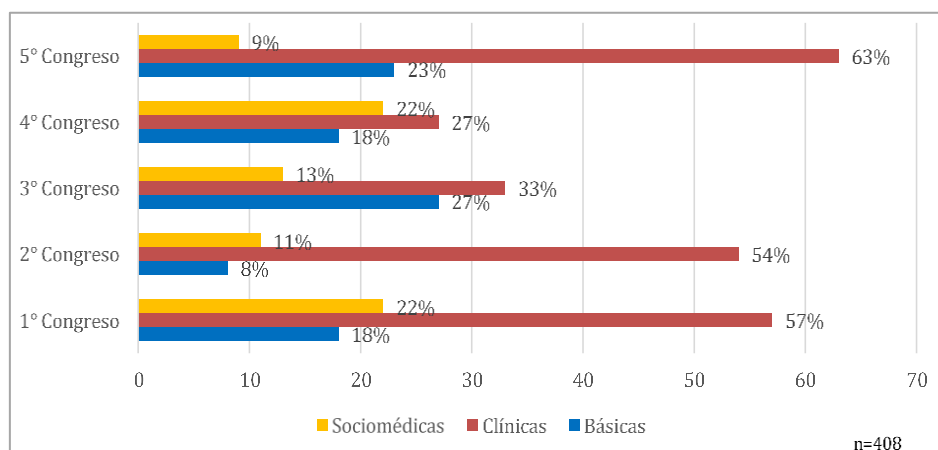
ation of new knowledge in the development of medicine. They include disciplines such as cellular and molecular biology, embryology, physiology, biochemistry, microbiology, pathology, genetics, pharmacology, and toxicology, among others. The clinical sciences focus on the analysis of clinical practice and method, as well as the similarities and differences with the scientific method. They encompass areas such as Internal Medicine, Surgery, Emergency Medicine, Pediatrics, Gynecology, and Obstetrics, among others. Finally, the sociomedical sciences are based on the social determination of health needs. These disciplines include Public Health, Psychiatry, Clinical Epidemiology, Medical Anthropology, History of Medicine, and Medical Bioethics.

These academic events, common in the lives of health care professionals, play a significant role in student development, providing them with training experiences that enhance their curriculum and equip them with the skills necessary to function effectively and effectively in these environments. They also allow students to become familiar with the most common topics discussed at these types of conferences. [8] (Morales, 1998).

Analyzing these academic events provides valuable information about students' areas of interest, as well as the impact of diseases on society. It also allows us to appreciate the development of critical thinking, which is essential for research in various academic and scientific fields [7, 5].

The objective of this paper is to analyze the information collected from the various academic conferences of the PAEA program, through a detailed study and reporting of the data obtained. The information will be classified according to the areas of basic, clinical, and sociomedical sciences and the subsequent impact of the research topics chosen by the students at the various conferences will be examined.

As can be seen below, the clinical area is the most in-demand, which is understandable because, according to its curriculum, it is primarily developed in hospital settings, which facilitates closer contact with tutors who cover a variety of topics (Figure 1).



Source: Figure 1. PAEA Coordination, Own elaboration, 2024.

Figure 1. Distribution of research papers by students according to their area of interest.

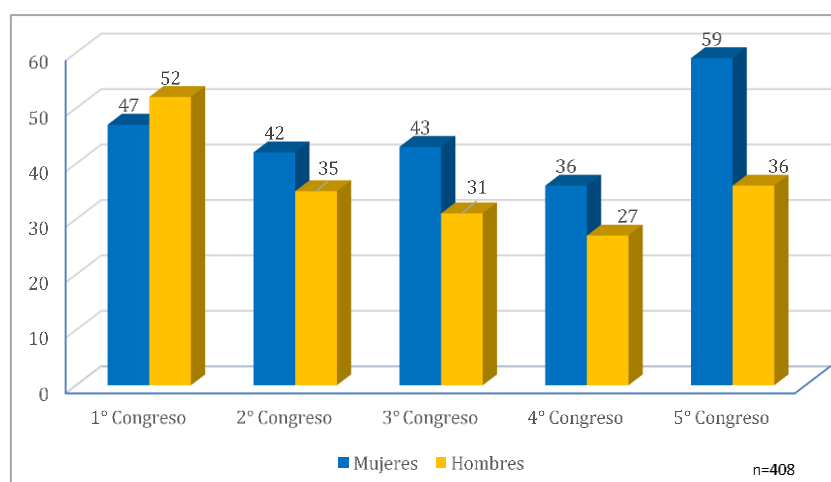
Figure 1. The figure shows the percentage distribution of each student's areas of interest over five years.

To conduct this analysis, a descriptive cross-sectional study was conducted, encompassing data collected from the five conferences organized by PAEA between 2019 and 2023. The research topics selected by the students were examined, as well as their distribution across the various areas of study. The

data was analyzed using descriptive statistical methods, cluster analysis, and factor analysis.

During the first events, gender-balanced participation was observed; however, during the pandemic, there was a slight decrease in male participation. However, at the last event, an increase in male participation was observed.

Figure 2



Source: **Figure 2.** PAEA Coordination, Own elaboration: 2024.

Figure 2. Gender Distribution 2019-2024 Congress PAEA.

Figure 2. The figure shows the percentage distribution by gender of the students who participated in PAEA academic conferences each year.

Of the five congresses held by PAEA, the first was in person (2019), the three subsequent ones were virtual due to the SARS-COV2 pandemic (2020-2021-2022), and finally, the most recent (5th Congress) was held in person again. In total, the five editions of the PAEA congress have had the participation of 408 students, 206 women and 202 men, with 256 projects presented.

At the 2019 congress, 56 projects were submitted, with the participation of 97 students, respectively. Of these, 13 were related to basic sciences, 34 to clinical sciences, and 9 to

sociomedical sciences. The 2020 congress, which was the first congress to be held online, received a total of 44 projects from 74 students, with 33 projects in clinical sciences, 6 in basic sciences, and 5 in sociomedical sciences. In 2021, the congress received 39 projects from 74 students: 20 in clinical sciences, 14 in basic sciences, and 5 in sociomedical sciences. The 2022 congress received 44 projects from 68 students, with 20 projects in clinical sciences, 11 in basic sciences, and 13 in sociomedical sciences. Finally, the most recent Congress in November 2023 received 73 projects with 95 students, 47 projects in clinical sciences; 19 projects in basic sciences and 7 in sociomedical sciences, as described in the following **Table 1.**

Table 1. Distribution of areas of interest in the PAEA Congresses 2019-2023.

Congress	Number of students	Projects presented	Basic sciences	Clinical sciences	Sociomedical sciences
1st	97	56	13	34	9
2 °	74	44	6	33	5
3 °	74	39	14	20	5
4 °	68	44	11	20	13
5 °	95	73	19	47	7

Congress	Number of students	Projects presented	Basic sciences	Clinical sciences	Sociomedical sciences
TOTAL	408	256	63	154	39

Source: [Table 1](#). PAEA Coordination, Own elaboration: 2024.

Table 1: The table shows the number of students by area of interest during each of the five academic conferences held annually.

3. Discussion

As can be seen, the area of greatest interest at the PAEA Congresses was clinical sciences, with a total of 154 papers presented at the five congresses, compared to 63 in basic sciences and 39 in sociomedical sciences. Within the clinical field, the topics of greatest interest to students were related to chronic degenerative diseases, various types of cancer, and infectious diseases, including COVID-19, reflecting an interest in topics of current relevance.

Secondly, in the basic sciences, topics related to obesity, infectious diseases, the study of various hormones, and innovative medications for various diseases were frequent.

Finally, in the area of socio-medical sciences, topics such as depression, anxiety, and sociodemographic characteristics related to various diseases and population problems, such as cervical, lung, and prostate cancer, were highlighted. Important topics such as addiction and the use of marijuana, heroin, tobacco, and alcohol were also addressed.

Several articles emphasize the importance of incorporating research into the curriculum of higher education students. Training allows them to develop new research skills, even through the use of virtual learning environments. Research capacity is a process of individual development that leads to deeper levels of knowledge, and it is crucial that it be aligned with the level of undergraduate students. Barrios & Ulises (2020), [2] who designed and validated a questionnaire to measure the attitude of university students towards research, concluding that factors such as motivation, self-confidence and teaching support directly influence said attitude, have also addressed this positive disposition towards research.

On the other hand, some experts point out that student research is an integral part of the teaching-learning process, as it helps students answer questions, generate new knowledge, and develop critical thinking skills (P ástor, 2020 & Vital, 2015) [9, 16]. However, the teacher's attitude plays a fundamental role in this activity, as they must not only motivate it but also actively reinforce it. Finally, Roman íRoman í and Guti érez (2022) [12] reinforce this vision by showing how a curricular strategy focused on research competencies can positively modify attitudes and perceptions towards research in medical students, enhancing their involvement in scientific processes from basic training.

4. Conclusions

Based on the above, a notable interest in the area of clinical sciences is evident, which corresponds to the students' academic progress in subsequent years. This is because most of them show an inclination toward completing a medical residency at various health institutes, which implies a focus on clinical practice and patient care. Subsequently, an interest is observed in the core areas, where the focuses are related to the diagnosis and treatment of diseases, which is also aligned with their future career paths.

In the sociomedical field, the focus is primarily on psychiatry and epidemiology, approaches of great relevance to future professionals.

The organization of academic conferences in our area is of utmost importance. Likewise, the active participation of students in these events from their early years is crucial. This aligns with their initial expectations upon entering the Highly Demanding Academic Program (PAEA), where students' motivation and aspirations transcend their curricular workload, as the demands and responsibilities are valuable to their training. This participation contributes to the goal of training health professionals who are familiar with research in various areas of the health sciences.

Finally, to conclude, the inclusion of this introductory strategy in the curriculum map for students, especially those focused on the sciences, can yield extraordinary results, as highlighted by various studies. This preliminary assessment of teaching research methods and strategies for integrating students into these practices reveals significant challenges that may arise in future experiences of early research involvement. Among these challenges are, for example, the division of more complex tasks and the need to expand interdisciplinary offerings in student training.

Abbreviations

PAEA	High Academic Excellence Program
UNAM	National Autonomous University of Mexico

Author Contributions

Aurora Farf án M árquez is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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