# Evaluation of a Program to Develop Research Skills in Health Sciences Students

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Graphic Abstract
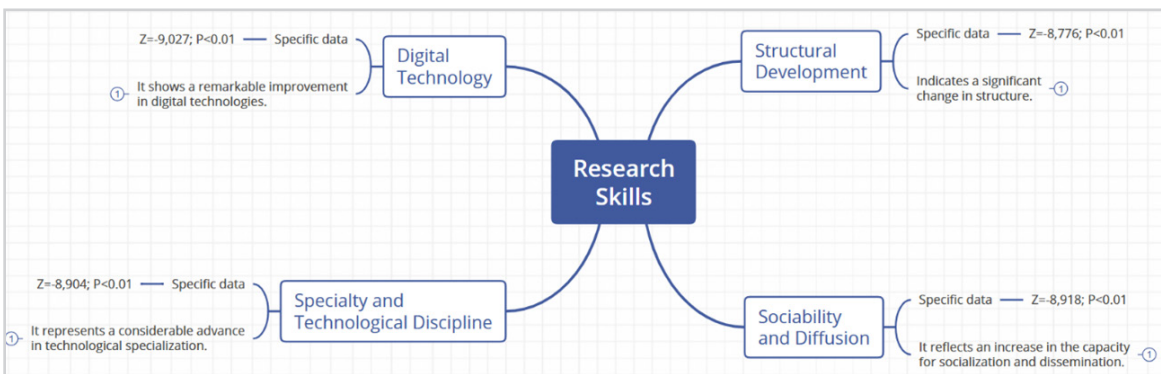
Abstract

The development of investigative skills is a challenge in higher education, as university students must be capable of generating knowledge and solving problems. This study aimed to evaluate the development of these skills in university students in Puno, specifically health sciences students. The research adopted a quasi-experimental design, suitable for measuring changes in a group before and after the intervention. To assess the effectiveness of the investigative skills development program, the Wilcoxon signed-rank test was used—a robust statistical tool for comparing two related samples when data normality cannot be assumed. The study involved 111 biomedical students who participated in a program designed to enhance their research skills. The results reveal significant findings in various areas of research skill development. Notably, there was a strong impact on structural development, with a Z-value of -8.776 (P<0.01), while sociability and dissemination showed a Z-value of -8.918 (P<0.01), suggesting that these factors play an important role in interaction effectiveness. Digital technology, with a Z-value of -9.027 (P<0.01), emphasizes the importance of digital tools in the research context. Finally, specialty and technological discipline displayed a Z-value of -8.904 (P<0.01), underscoring the relevance of specialization in the technological field. The program for developing research skills proved to be effective.

Keywords: Structural Development. Dissemination. Skills. Research. Sociability. Digital Technology.

INTRODUCTION

The development of investigative skills in higher education has been the subject of numerous studies; however, many lack practical approaches that integrate theory with classroom application. Traditional methods generally focus on knowledge transmission without fostering student autonomy and critical thinking. This gap between theory and practice has led to a deficit in students' ability to autonomously generate knowledge and solve complex problems[1]. In this context, the tested program represents a significant innovation, as it not only addresses these limitations but also introduces active methodologies that empower students to engage in their own learning process. However, students' perceptions of their skill development remain below expectations, providing deeper insights into the current state of investigative skills training and professional competencies[2]. Additionally, neuroeducation and cooperative learning have been identified as effective strategies for developing investigative skills in university students, although their implementation may vary depending on the context and institution[3]. Overall, developing investigative skills is an urgent need for professionalization and success in the job market, making it essential to address this issue effectively in higher education so that students can generate knowledge and solve problems efficiently[4]. For future health professionals and technicians to effectively meet sector challenges and improve people's quality of life, it is essential to integrate a research-oriented mindset into undergraduate academic activities[1]. Research plays a crucial role in the comprehensive education of students; however, this process does not occur spontaneously it requires deliberate planning, guidance, and supervision from faculty, making it an integral part of various program curricula[1]. Developing investigative skills is imperative, as research not only constitutes a fundamental process within the university but also serves as an essential function in professional practice. This training equips graduates to successfully meet the demands of contemporary scientific and technical development[5].

The state of investigative skills in Peru is a relevant topic in higher education[6]. In health-related courses, it was observed that students have a limited perception of investigative skills, highlighting the need for faculty to be researchers, not merely research theorists[7]. Additionally, at a private university in Lima, students were found to have a limited self-assessment of their investigative skills, with a median of 2.0 perceived skills out of a possible 7.0, and only 71.2% of students reported an intention to pursue research as a career[8]. In another study, results revealed that the level of investigative skills was predominantly low, with only 9.0% of students reaching a high level[7]. Another study found that investigative skills significantly influence the writing and dissemination of findings among students at a private university in Ica, suggesting that the development of these skills is crucial for academic success[9].

Investigative skills are essential for university students in health sciences, as they foster the critical and analytical thinking necessary to address complex issues in healthcare[10]. The ability to conduct rigorous research enables these students to contribute to the advancement of scientific knowledge, improve clinical practices, and develop new strategies for disease prevention and treatment[11,12]. Additionally, investigative skills enhance future professionals' ability to stay updated with the latest advancements and to adapt their practices based on the most recent evidence. This is crucial for providing quality care and improving health outcomes for the population[13,14]. Therefore, the objective of this study was to evaluate the development of investigative skills among university students in health sciences at the Universidad Nacional del Altiplano de Puno.

METHOD

This study employed a quasi-experimental design and was conducted at the Universidad Nacional del Altiplano in Puno, Peru, using a quantitative approach. A total of 111 volunteer students from the eighth and tenth semesters of the professional programs in Biology, Nursing, Veterinary Medicine and Animal Science, Human Nutrition, and Dentistry participated in the research. Below, we present the demographic and professional characteristics of the participants. The majority of students (55%, n=61) were between 21 and 24 years old, indicating a predominantly young adult population. Additionally, 27.9% (n=31) were over 24 years old, while only 17.1% (n=19) were under 21. Regarding gender distribution, most participants were female (57.7%, n=64), while males comprised 42.3% (n=47). In terms of professional programs, the largest group consisted of Dentistry students (62.2%, n=69), highlighting the program's popularity among participants. This was followed by Veterinary Medicine students (18.9%, n=21), Human Nutrition (9.9%, n=11), Nursing (6.3%, n=7), and Biology (3.2%, n=3). These results illustrate a diverse representation of academic disciplines, providing an overall view of the student population involved in the study.

Table 1 - Sociodemographic Variables of Students Participating in the Study in 2023.

Variables	X±DE	N	%
Age	**23.07±34.28**		
Under 21 years old		19	17.1
From 21 to 24 years old		61	55.0
Over 24 years old		31	27.9
Sex			
Female		64	57.7
Male		47	42.3
Professional Career			
Biology		3	3.2
Nursing		7	6.3
Veterinary Medicine and Animal Science		21	18.9
Human Nutrition		11	9.9
Dentistry		69	62.2

The study received approval from the Institutional Ethics Committee of the Universidad Nacional del Altiplano, with registration number N° 037-2023/CIEI UNA-PUNO. The research was conducted over a three-month period, from October to December 2023. It is essential to highlight the inclusion criteria for the study sample: participants were required to be regularly enrolled students in the 8th to 10th semesters of the 2023-II academic cycle. On the other hand, exclusion criteria included students who chose not to participate in the Research Skills Workshop (*Taller de Habilidades para la Investigación*) and those who did not fully complete the workshop; these individuals were subsequently removed from the sample. Additionally, a voluntary withdrawal criterion was established, allowing students to request to quit the study at any time.

The researchers developed a 36-item questionnaire organized into 4 dimensions: investigative skills divided into various essential categories. Structural development skills enable the organization and coherent presentation of information, covering project design, content organization, and the drafting of clear reports. Socialization and dissemination skills are crucial for effectively communicating results, including teamwork, oral presentations, and dissemination across various platforms. Digital technological skills involve the use of tools and software for research, online information retrieval, and digital communication[15]. Finally, specialty or technological discipline skills encompass knowledge and competencies specific to each field of study, allowing for the application of techniques and innovation in the respective area. Together, these skills are essential for conducting quality research and contributing to knowledge across various disciplines. The instrument developed for participant evaluation demonstrated notable reliability, with a Cronbach's alpha coefficient of $\alpha = 0.874$. This value indicates that the instrument has high internal consistency, suggesting that the different questions or items coherently measure the same construct.

The "Researching in Health" (*Investigando en Salud*) program was implemented in the study, structured around the development of 4 main topics: Investigative Skills, Structural Development Skills, Socialization and Dissemination Skills, and Digital Technological Skills. The workshops were conducted over four theoretical-practical sessions, scheduled with a three-week interval between each, providing participants with sufficient time to complete assigned tasks and ensure that the objectives proposed for each workshop were met. These workshops were led by specialists in investigative skills development, who are also research professors qualified by the National Council for Science and Technology of Peru. The theoretical sessions were conducted in person and covered the following aspects: the scientific method, research project design, bibliographic standards (APA – Vancouver), scientific articles, ethics in biomedical research, considerations of the UNAP ethics committee, the importance and strategies of investigative socialization, bibliographic search engines in Health Sciences, similarity detection software, biostatistics concepts, reference managers, and technological advances in research. During the practical sessions, participants had the opportunity to concretely apply the concepts and skills acquired throughout the workshop. Each participant chose a topic of interest and prepared a scientific report, allowing them to integrate theoretical knowledge with investigative practice. This exercise not only enhanced their critical analysis skills but also provided the experience of structuring a scientific work.

The data obtained were analyzed using the Wilcoxon signed-rank test to assess the effectiveness of the investigative skills development program in health sciences students. This analysis considered four main dimensions: Structural Development, Socialization and Dissemination, Digital Technology, and Specialty and Technological Discipline. Each of these dimensions was essential for understanding how the program impacted participants' competencies. The results across all analyses showed statistically significant relevance, with P-values <0.05, indicating that the observed improvements are significant and not due to chance. Calculations were conducted using IBM SPSS software, version 26, ensuring robust and reliable data analysis. This analytical

approach not only validated the program's effectiveness but also provided valuable insights for future improvements and adaptations in training workshop design.

RESULTS

Table 2 - Influence of the "Researching in Health" Program on the Development of Investigative Skills in Health Sciences Students.

Investigative Skills	Pre	Post	Z	p
Structural Development	2.36± 0.795	3.98 ± 0.603	-8.776A	.000*
Socialization and Dissemination	2.13 ± 0.728	4.06 ± 0.651	-8.918A	.000*
Digital Technology	1.81 ± 0.625	3.95 ± 0.578	-9.027A	.000*
Specialty and Technological Discipline	1.99 ± 0.681	3.88± 0.568	-8.904A	.000*

Source: Research Data a Wilcoxon Signed-Rank Test (Z).
• $p<0.0001$

The investigative skills development program implemented with biomedical students significantly influenced the structural development of investigative skills ($Z = -8.776$; $p<0.001$), as students were able to develop a methodical and organized process to acquire and enhance essential research competencies. This approach involves implementing pedagogical strategies and practices designed to guide students through various stages of the investigative process, from formulating research questions to disseminating results. This was demonstrated by the average structural development of investigative skills before and after program implementation, which was 2.36 ± 0.795 and 3.98 ± 0.603, respectively.

The implemented program significantly influenced sociability and knowledge dissemination ($Z = -8.918$; $p<0.001$), as students were able to socialize and share knowledge with other university students in health-related fields, which is crucial for training competent professionals committed to the community. This was evidenced by the average sociability and dissemination scores before and after program implementation, which were 2.13 ± 0.728 and 4.06 ± 0.651, respectively.

The program also had a significant impact on the handling of digital technology for information retrieval a fundamental skill for conducting research during undergraduate studies ($Z = -9.027$; $p<0.001$) as students were able to effectively use digital technology to seek information, an essential skill for research at the undergraduate level, especially in a world where access to data and electronic resources is vast and constantly evolving. This was demonstrated by the average digital technology scores before and after the program, which were 1.81 ± 0.625 and 3.95 ± 0.578, respectively.

The developed program significantly influenced the handling of specialty and technological discipline (Z = -8.904; p<0.001), as students delved deeper into specific knowledge areas and effectively applied advanced technologies. In an increasingly complex and competitive academic and work environment, specialization enables the development of technical competencies and in-depth knowledge in a particular field, which is crucial for innovation and leadership in the industry. On the other hand, technological discipline implies a structured and methodical approach to using and applying technologies, ensuring they are implemented efficiently and ethically. This was demonstrated by the average specialty and technological discipline scores before and after program implementation, which were 1.99 ± 0.681 and 3.88 ± 0.568, respectively.

DISCUSSION

The program designed for students in biomedical fields had a significant impact on the structural development of these skills (Z = -8.776; p<0.001). Skill development is closely tied to training health sciences professionals, as these skills enable students to build essential research competencies, especially in university education[16,17]. These skills are not only fundamental for professional practice but also equip students with key competencies for research, which is crucial in a constantly evolving field[18]. Integrating innovative methodologies into the curriculum, as observed in various educational initiatives, can further enhance these skills, thereby improving the quality of the teaching-learning process and contributing to solving health issues in society[19]. Therefore, it is imperative for educational institutions to continue refining their training programs to ensure that future professionals are equipped with the tools necessary to meet the challenges in the health sector and contribute to scientific and technological advancements in their respective fields.

The development program had a significant impact on sociability and knowledge dissemination, as demonstrated by the statistical results (Z = -8.918; p<0.001). This ability to socialize and share knowledge is fundamental for training competent professionals committed to the community[20]. By enabling students to share and discuss their findings with other biomedical students, the program fosters collaboration and the exchange of ideas, which are crucial for building knowledge and solving complex health-related problems[17]. Furthermore, this capacity for knowledge dissemination is essential for the practical application of research results and informed decision-making in healthcare, as highlighted by[21]. In this regard, the investigative skills development program contributed significantly to preparing health professionals capable of effectively communicating and sharing their knowledge.

The program also significantly impacted the handling of digital technology for information retrieval, an essential skill for undergraduate research (Z = -9.027; p<0.001). In an environment where access to vast and constantly evolving electronic resources is common, students' ability to navigate and effectively use digital tools is crucial for conducting meaningful research[22]. This need is underscored by findings suggesting that many students, despite being labeled "digital natives," often lack the advanced information literacy skills necessary for academic success[23]. Therefore, educational institutions should prioritize the development of these competencies within their curricula to prepare students for the demands of modern research environments. By integrating specific training in digital competencies, programs can enhance students' research capabilities and ultimately foster a generation of professionals who are not only proficient in technology use but also able to engage critically with the information they encounter[24].

The implemented program significantly impacted the handling of specialty and technological discipline (Z = -8.904; p<0.001). This improvement enables students to deepen their knowledge in specific areas while effectively applying advanced technologies. The practical implications of this advancement are profound, particularly in preparing students for the demands of a rapidly evolving job market, where

technological competence is paramount[25]. As industries increasingly rely on sophisticated technologies, equipping students with the ability to navigate and effectively use these tools ensures they remain competitive and capable of contributing to innovation in their fields[26]. Additionally, fostering specialized knowledge through targeted educational programs can lead to more informed decision-making and problem-solving skills, which are essential in today's complex professional environments[27]. Consequently, educational institutions should prioritize the integration of advanced technological training into their curricula, not only to improve academic outcomes but also to prepare students for successful careers in an increasingly digital landscape.

CONCLUSION

The program designed for biomedicine students had a significant impact on the structural development of essential competencies, as indicated by robust statistical analysis. This finding highlights the program's effectiveness in enhancing students' abilities, which is important for their academic and professional growth. By fostering these skills, the program contributes not only to the individual development of students but also strengthens the overall quality of education in the health sciences field. Moreover, the development of these competencies is intrinsically linked to the training of future health professionals. The skills acquired through this program are vital for conducting research and navigating the complexities of healthcare. As students acquire these essential skills, they are better prepared to face real-world challenges in their future careers. This underscores the importance of integrating skill development into biomedical education, ensuring that graduates are well-prepared to excel both in research and in practical applications within the healthcare sector.

This improvement in digital competency is vital in today's academic landscape, where access to vast and rapidly evolving electronic resources is the norm. By equipping students with the necessary skills to navigate and effectively use digital tools, the program ensures they are well-prepared to engage in meaningful research activities. Additionally, proficiency in digital technology not only facilitates the research process but also fosters a culture of innovation and critical thinking among students. As they become proficient in utilizing digital resources, they are better positioned to conduct comprehensive research and contribute valuable findings to their fields. This underscores the importance of integrating digital literacy into educational programs, empowering students to harness technology effectively and enhancing their overall research capabilities in an increasingly digital world.

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