
Multimed 2026; 30:e3252

Original article

Characterization of the development of statistical-investigative skills in undergraduate students in Clinical Bioanalysis

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ABSTRACT

The teaching of statistics should focus on solving contextualized problems. The objective of this research is to characterize the current state of the development of statistical-research skills in students of the Clinical Bioanalysis program. A cross-sectional descriptive study was conducted with 27 third-year students during the first period of the 2025-2026 academic year. An observation guide was used for 10 curricular and extracurricular teaching activities; a questionnaire was applied to the students, and 10 teachers were interviewed. The results showed a deficient rating in the criterion of practical application in research in 70 % of the observations. Students with a low level predominated at 55.6 %. Teachers stated that curricular disconnection and a deficit in knowledge transfer are the root causes, due to a lack of integration and



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practical application. The applied triangulation provides a comprehensive and reliable view of the current state of statistical-research skills in the Clinical Bioanalysis program, allowing for a structured approach to optimize both teacher and student training.

Keywords: Skills; Statistical-research; Clinical bioanalysis.

Received: 7/11/2025

Approved: 22/01/2026

Introduction

Currently, statistics has become a fundamental element in the academic and professional training of individuals, which allows for a greater presence in the curricula of various countries and fosters a significant increase in scientific production and events dedicated to its teaching and learning. (1)

However, statistics taught in university classrooms continues to focus on procedural aspects (formulas) and faces the challenge of generating more active and collaborative learning spaces that result in application to students' everyday lives. (2) In this way, it is possible to demonstrate that statistics is significant beyond the classroom. (3)

To achieve this significance, the teaching of statistics should focus on solving contextualized problems and implementing active methodologies such as inquiry-based learning and project-based learning. (4)

In the Cuban health sector, the use of statistical methods plays a fundamental role in achieving excellence in the services provided to the population. Therefore, it is necessary to introduce students in health technology programs to statistical knowledge, coherently integrating the analysis and interpretation of data obtained from both qualitative and quantitative scientific research. This involves applying instruments and techniques that allow them to organize, systematize, process, and analyze this information, thereby arriving at the necessary conclusions for making predictions, assessments, and decisions in the field of health, with a focus on hygiene



and epidemiology and considering the environmental conditions in communities to preserve the population's health. (5)

Research skills are a contemporary necessity. Beyond their beneficial impact on academic success, research skills have also demonstrated a positive influence on the professional work of recent graduates, transforming their work into an outstanding and effective practice in solving socially relevant problems. (6) Although placing special emphasis on the development of these skills is an inherent activity in all higher education institutions, some studies indicate that they have not been developed to an adequate level; (7) however, students in the Clinical Bioanalysis program show deficiencies in the development of statistical-research skills; therefore, the following objective is proposed: to characterize the current state of the development of statistical-research skills in students of the Clinical Bioanalysis program.

Methods

A cross-sectional descriptive study was conducted to diagnose the development of statistical-investigative skills in students of the Bachelor's Degree in Clinical Bioanalysis of the Celia Sánchez Manduley Faculty of Medical Sciences of Manzanillo during the first period of the 2025-2026 course.

The population consisted of 147 students and 31 professors from the Clinical Bioanalysis degree program. The sample was selected intentionally and comprised the 27 students currently in their third year and 10 professors.

Students' approval to participate in the research was obtained through informed consent.

Data collection techniques

The observation was made of 10 presentations of scientific work (six from the subject Research Methodology and four from participation in events) with the objective of evaluating the integration and application of statistical-investigative skills in independent work and in scientific events.



The following classification was taken into account for the overall assessment of the observation:

- Deficient: does not meet
- Insufficient: minimally meets requirements
- Acceptable: partially meets requirements
- Good: It performs adequately.

An eight-question questionnaire (7) was applied to third-year students with the objective of evaluating knowledge, practical application and critical analysis in statistics applied to scientific research.

The following scale was used to assess the level of knowledge:

- Stop: Answer all 8 questions correctly
- Average: 6-7 correct answers
- Low: fewer than 6 correct answers

Ten professors were interviewed (two from Statistics, two from Research Methodology and six teachers specific to the profession in question).

Data processing

Data processing was carried out through descriptive statistics using absolute numbers and percentages; and triangulation of the results was performed to summarize the contributions of each data collection technique used.

Results

Table 1 shows the results of the observations made on the 10 curricular and extracurricular teaching activities. The criterion of practical application in research received a poor rating in 70% of the observations; and the following criteria were deemed insufficient: use of examples and teaching materials, promotion of



participation and interaction, integration of technological tools, and formative assessment in 60% of the total.

Table 1. Observations made on curricular and extracurricular teaching activities.

Criteria	Overall rating							
	Deficient		Insufficient		Acceptable		Well	
	No.	%	No.	%	No.	%	No.	%
Preparation and mastery of the content	--	--	--	--	5	50.0	5	50.0
Use of examples and teaching materials	--	--	6	60.0	4	40.0	--	--
Promoting participation and interaction	--	--	6	60.0	4	40.0	--	--
Practical application in research	7	70.0	2	20.0	1	10.0	--	--
Handling difficulties and complex questions	5	50.0	2	20.0	3	30.0	--	--
Integration of technological tools	3	30.0	6	60.0	1	10.0	--	--
Formative assessment	--	--	6	60.0	4	40.0	--	--
Attitude and motivation	3	30.0	4	40.0	3	30.0	--	--

Regarding the results of the questionnaire applied to the students, Table 2, it can be observed that 15 students for 55.6% have a low level, followed by medium with 10 for 37%.

Table 2. Questionnaire on statistical-investigative skills in students of the Clinical Bioanalysis career.

Level of knowledge	No.	%
High	2	7.4
Half	10	37.0
Low	15	55.6
Total	27	100

Regarding the interview conducted with the teachers, the following difficulties were observed:

Category 1: Curriculum disconnection and fragmentation of knowledge

- There is a significant gap between the teaching of tools (Statistics), methods (Research Methodology), and their professional application (Clinical Bioanalysis). Knowledge is perceived as disconnected "islands."

Category 2: Deficit in transfer and practical application

- Students show difficulties in transferring abstract statistical concepts to real clinical laboratory situations, as they fail in contextualized interpretation.

Category 3: Specific difficulties with the qualitative approach

- The qualitative research paradigm is particularly problematic, perceived as "subjective" and "unscientific" by students accustomed to quantification.

Category 4: Logistical and teacher training barriers

- Institutional factors and limited resources hinder the implementation of more effective teaching strategies.

The methodological triangulation performed on the results of this research allows us to state with a high degree of confidence that:

- Direct evidence (observation) visually and behaviorally confirms these deficiencies, showing a mechanical use of tools, poor interpretations, and an inability to defend arguments rigorously.
- The students (questionnaire) acknowledge having difficulties, especially in coding, interpretation, and critical thinking.
- The teachers (interviews) diagnose a curricular disconnect and a deficit in transfer as the root causes, pointing to a lack of integration and practical application.

Discussion

The findings in this research are due to the fact that simulated examples are often used and on-the-job training is not used to collect real data from each health unit.

Similar studies reveal the challenges that statistics teaching still faces: low results on standardized tests, shortcomings in curricula as identified by textbook reviews, the



inherent difficulties of the discipline, such as addressing fundamental statistical ideas, and the beliefs and attitudes of students and teachers towards this discipline. (8)

When analyzing the results of the cooperative domain dimension, Chávez observed that the low level is the value with the highest percentage (51.6%). This value implies that students do not usually participate proactively in collaborative work nor are they able to assume responsibilities when working together. (7)

In that same investigation, the analysis of the technological mastery dimension showed a predominance of the low level (95.9%), which demonstrates that students experience serious difficulties in operating office software, as well as digital readers, statistical software and bibliographic managers. (7)

The information gathered through observation provides a level of objectivity to complement the self-assessments of teachers and students, allowing for the identification of areas for training and improvement.

The results obtained in the student survey coincide with those obtained by Del Callejo, Canal and Hákim, where the majority of students failed to relate and apply the correct statistical technique to the research question and therefore were also unable to write or orally explain their findings clearly, in addition to not submitting the required progress reports; 20% of the students have significant difficulties in writing and orally explaining their findings. (9)

Statistics are indispensable for quantifying phenomena that affect society and making decisions oriented towards the common good based on valid and reliable data. In the analysis of the analytical and interpretive domain, a predominance of the low level was observed (59.0%), which demonstrates that the majority of respondents do not master statistical techniques relevant to the analysis of quantitative data and shows that they have not developed the ability to interpret the results of an investigation and make decisions based on them. (7)

In a study conducted at the University of Peru, 55.3% (48) of the students showed a low level in the research skills variable. (10)

The students expressed some lack of knowledge or less experience in the applied use of statistics, while the teachers, although better trained, do not always integrate these practices into teaching, as the observation showed.

We agree with Ricardo,⁽¹¹⁾ where students' statistical skills face significant difficulties in understanding fundamental concepts, highlighting the need to implement innovative and active teaching methods, such as the use of technology, to improve learning and mitigate student anxiety.

Some authors agree that students face serious difficulties in understanding fundamental statistical concepts, a problem exacerbated by a lack of prior knowledge acquired in their previous education; this deficiency limits their ability to tackle advanced topics in higher education, and highlights the need to implement more effective instructional methods, such as project-based learning (PBL), that address these deficiencies and facilitate a better understanding of statistics. (12,13)

The authors also state that although students recognize the importance of statistics, they often have difficulty identifying its practical applications, which can lead to a lack of motivation in learning. This problem may stem from a traditional teaching approach that does not encourage data analysis or the development of critical thinking skills. (14,15)

Data triangulation is used with the intention of cross-checking different sources, which makes it possible to reach general conclusions.

The results obtained in the triangulation coincide with the exploratory study carried out on the teaching-learning process of health technologists, which revealed through methodological triangulation that the variable of use of the investigative approach in the teaching-learning process of Chemistry in Health Technology is highly affected in all its dimensions. (16)

Castañeda found through triangulation that the applied instruments revealed the deficiencies that students have in the application of statistical techniques, and the limitations shown by teachers in facilitating the implementation of learning strategies to contribute to the transition through the levels of content assimilation, and thus to its application. (16)



Applied triangulation provides a comprehensive and reliable view of the current state of statistical-investigative skills in the Clinical Bioanalysis career, allowing a structured approach to optimize teacher and student training.

Conclusions

The development of statistical and research skills in second-year undergraduate students of Clinical Bioanalysis is characterized by a fragmented and superficial mastery. A significant gap exists between the theoretical understanding of isolated statistical concepts and their integrated, critical, and contextualized application in real or simulated research scenarios.

Bibliographic references

1. García García JI. The contagion of data. The importance of statistical literacy. In: Sagula JE, Agudo DO. II Symposium on Virtual Mathematics Education, Mathematics Education Enriched by Interdisciplinarity with Technology [Internet]. Luján: EdUnLu; 2021. [cited 21/01/2026] Available from: <https://doi.org/10.13140/RG.2.2.18297.34408>
2. Aviña Camacho I. Development of statistical skills in university students through a contextualized teaching strategy. MES [Internet]. 2025 [cited 2025 Sep 14]; 8(2): 28-42. Available from: <https://journals.uco.es/mes/article/view/18404/16409>
3. León NA. Scope of statistics teaching through research in secondary education in Venezuela. Paradigma [Internet]. 2020 [cited 2025 Sep 14]; 41: 657–84. Available from: <https://mail.revistaparadigma.com.br/index.php/paradigma/article/view/808/805>
4. León Gómez NA. Teaching statistics meaningfully and in context through problem-solving. Reality and Reflection [Internet]. 2021 [cited 2025 Sep 14]; 21(53):228–53. Available from: <http://ri.ufg.edu.sv/jspui/bitstream/11592/9674/1/Ense%C3%B1anza%20de%20la%20Estad%C3%ADstica%20con%20sentido%20y%20en%20contexto.pdf>



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5. López Fernández AG, Ramírez Vale R, Santander Montes AJ, Salgado Friol AH. Project-based learning in the teaching of Inferential Statistics. RCIM [Internet]. 2018 [cited 2026 Jan 21]; 10(2): Available from: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1684-18592018000200012
 6. Sandy Manuel Rigual Delgado 6. Vera Rivero DA, Chirino-Sánchez L, Ferrer Orozco L, Blanco Barbeito N, Amechazurra Oliva M, Machado Caraball DL, et al. Self-assessment of research skills in student assistants at a medical university in Cuba. Medical Education [Internet]. 2021 [cited 2025 Sep 14]; 22(1): 20-6. Available from: <https://www.sciencedirect.com/science/article/pii/S1575181318303516?via%3Dihub>
 7. Chávez Ayala C, Farfán Córdova N, San Lucas Poveda H, Falquez Jaramillo J. Construction and validation of a research skills scale for university students. Rev. Innova Educación [Internet]. 2023 [cited 2025 Sep 14]; 5(2): 62-78. Available from: <https://revistainnovaeducacion.com/index.php/rie/article/view/812/757>
 8. Tan AJY, Davies J, Nicolson RI, Karaminis T. A technology-enhanced learning intervention for statistics in higher education using bite-sized video-based learning and precision teaching. Research and Practice in Technology Enhanced Learning [Internet]. 2023 [cited 10/14/2025]; 18:1–27. Available in: <https://doi.org/10.58459/rptel.2023.18001>
 9. Del-Callejo Canal D, Canal Martínez M, Hákim Krayem MR. Development of statistical thinking in higher education students through an educational experience. Educación Matemática [Internet]. 2020 [cited 2025 Sep 16]; 32(2): 228–53. Available from: <http://www.revista-educacion-matematica.org.mx/descargas/vol32/2/08REM32-2.pdf>
 10. Rueda Milachay LJ, Torres Anaya L, Córdova García U. Development of research skills in students of a Peruvian university. Conrado [Internet]. 2022 [cited 2025 Sep 16]; 18(85): 66-72. Available from: <http://scielo.sld.cu/pdf/rc/v18n85/1990-8644-rc-18-85-66.pdf>
 11. Ricardo Suárez JM, Chasiguasín Tumbaco MA, Ramos Suárez GV. Statistical competencies in university students. A systematic review. University and Society

[Internet]. 2025 [cited 2025 Oct 13]; 17(2): e5096. Available from: <https://rus.ucf.edu.cu/index.php/rus/article/view/5096/4995>

12. Bautista-Gómez AJ, Millán-Alanís JM, De la Cruz-de la Cruz C, González-Martínez A, Velasco-Sepúlveda BH, Álvarez-Villalobos NA. Teaching medical statistics in medical schools: towards comprehensive training. Investigación en Educación Médica [Internet]. 2020 [cited 2025 Oct 13]; 9(36): 52–57. Available from: <https://riem.facmed.unam.mx/index.php/riem/article/view/608/733>

13. Bromage A, Pierce S, Reader T, Compton L. Teaching statistics to non-specialists: Challenges and strategies for success. Journal of Further and Higher Education [Internet]. 2022 [cited 10/13/2025]; 46(1): 46-61. Available in: <http://ecology.nottingham.ac.uk/tomreader/assets/pdf/Bromage%20et%20al%202021.pdf>

14. Ortiz Aguilar W, Ortega Chávez W, Valencia Cruzaty L, González Vásquez ÁE, Gamarra Mendoza S. The statistical education of engineers: a challenge for higher education. University and Society [Internet]. 2021 [cited 10/13/2025]; 13(5): 307-18. Available from: <http://scielo.sld.cu/pdf/rus/v13n5/2218-3620-rus-13-05-307.pdf>

15. Vergara Vera I. Methodology with an Investigative Approach in Health Technology. [Doctoral thesis]. Havana: University of Medical Sciences of Havana; 2017. Available from: <https://tesis.sld.cu/index.php?P=FullRecord&ID=672>

16. Campos Matos CM, Abad Camejo Y, Zayas González D de J. Didactic strategy to promote professional training in the physical culture degree. Journal of Social Innovation and Development [Internet]. 2024 [cited 2026 Jan 21]; 9(2): 517–34. Available from: <https://revista.ismm.edu.cu/index.php/indes/article/view/2670>

Conflicts of interest

There are no conflicts of interest among the authors.

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