Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 8
Open Access

Impact of Clinical Simulation on the Comprehensive Development of Competencies in Medical Students

Briones-Morales, Victor Euclides [1],Jurado-Fernández, Cristian Augusto [2],Rosero-Mendoza, Julio Ildefonso [3]

[1] César Vallejo University (UCV) of Piura, Peru. PhD Candidate in Teaching
[2] César Vallejo University (UCV) of Piura, Peru. Doctoral Tutor.
[3] César Vallejo University (UCV) of Piura, Peru. PhD Candidate in Teaching.

Cite this paper as: Briones-Morales, Victor Euclides ,Jurado-Fernández, Cristian Augusto ,Rosero-Mendoza, Julio Ildefonso (2024). Impact of Clinical Simulation on the Comprehensive Development of Competencies in Medical Students. *Frontiers in Health Informatics*, *13 (8) 1667-1679*

ABSTRACT
Introduction: Medical education seeks more than theoretical instruction; it pursues to develop practical and cognitive competencies through clinical simulation strategies, a tool that replicates complex and safe environments, fostering technical and soft skills; however, its global and Latin American adoption faces resource and training limitations.
Objective: To evaluate the relationship between the implementation of clinical simulation strategies and the development of professional competencies, based on the perception of medical students in an Ecuadorian university.
Methods: A positivist paradigm study was conducted, with a quantitative approach, non-experimental, descriptive-inferential, cross-sectional design, involving 93 eighth and ninth semester students, through the application of surveys with Likert-type scales to measure the perception of simulation (V1) and the development of competencies (V2). The data were processed in Excel and SPSS 25, using Spearman's correlation test to evaluate the relationship between the two study variables.
Results: 60% of the students considered the simulation as an effective strategy for learning; however, 34% showed average evaluations. Debriefing was positively evaluated by 66% of the participants, highlighting its relevance in the consolidation of learning. Spearman's correlation showed a moderate-high positive relationship (Rho=0.641, $p<0.01$) between simulation and competency development, suggesting that its improvement impacts favorably on student skills.
Conclusions: The findings confirm the effectiveness of clinical simulation in improving medical competencies, such as decision-making and teamwork, which coincides with previous work. However, there is evidence of problems to be solved, such as improvements in infrastructure and teacher training to maximize its impact on medical education.
Key words:
Medical learning, Health education, Medical training, Clinical simulation, Medical competencies, Skills development.

Introduction

Medical education faces the challenge of training professionals with solid competencies through the practical application of theoretical knowledge, enabling the development of skills to address complex situations. However, practicing on real patients may pose bioethical risks that affect both patient and student safety[1,2].

In response to these challenges, clinical simulation (CS) emerges as an ideal educational alternative, offering a safe and controlled environment where students can acquire skills without risking harm to others[3,4]. The greatest benefit lies in learning from errors through feedback and active, reflective learning about their actions, reinforcing self-confidence and clinical competence[5,6].

The design of simulation environments involves: (a) learning tasks that integrate knowledge and skills, (b) supporting data to theoretically sustain practice and reflective analysis, (c) detailed feedback during task performance, and (d) practicing partial tasks until achieving automation[7], through exercises resembling clinical reality[8].

Studies in English-speaking countries highlight that CS has become a consolidated educational strategy, increasing cognitive training by 30%[9,10]. European countries report that the use of high-fidelity mannequins and computerized simulations helps bridge the theoretical-practical gap[11,12]. In Latin America and the Caribbean, the adoption of simulation has progressed slowly[13]. In Brazil and Mexico, incorporating simulation into academic programs has proven effective[14], while in Colombia, an increase in emergency resolution skills has been documented[15].

In Peru, the lack of access to real clinical practices hinders the development of essential competencies, causing simulation to remain in an expansion phase[16,17,18]. However, it facilitates active learning, fosters critical thinking, and enables the assessment of academic performance[19,20]. Active learning involves direct participation, critical thinking development, teamwork, effective communication, and decision-making under pressure as fundamental skills[21,22]. Nevertheless, there is a gap in the literature, as well as a lack of trained personnel and adequate infrastructure[23].

The flexibility of clinical simulation programs allows for their implementation with optimized resources[24,25]. Virtualized environments provide a safe setting, optimizing the learning curve and preventing privacy violations[26,27]. Developing professional competencies is essential for ensuring safety and quality in healthcare delivery[28,29]. This study's importance lies in determining the degree of correlation between variables, identifying their benefits, advancements, and challenges, and justifying the need to promote comprehensive learning, generating data to support the implementation of CS as an essential component of medical education[30].

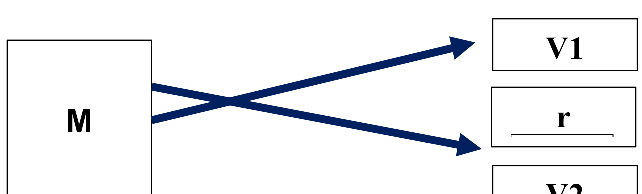
The use of simulation environments is rooted in Kolb's experiential learning theory (1984), which emphasizes the importance of learning through direct experience, as well as Vygotsky's sociocultural theory (1978), which highlights the role of practice with social interaction and underscores the importance of debriefing[31].

The study's research question is: What is the correlation between the use of clinical simulation strategies and the development of professional competencies in medical students at an Ecuadorian university? The objective of this study is to evaluate the correlation between the use of clinical simulation strategies and the development of professional competencies by assessing the perception of medical students at an Ecuadorian university. The hypothesis posited is that there is indeed a correlation between the use of clinical simulation strategies and the development of professional competencies.

Methodology

This study is grounded in the positivist paradigm, as it assumes an independent relationship between the individual who knows and the object to be known, adapting to the specificities of the research[32]. The approach was quantitative for both variables. It was a basic type of study since the researchers did not intervene to modify the study variables. The research design was non-experimental, with a descriptive, inferential, and correlational modality, and it was cross-sectional, as it was conducted at a single point in time[33].

For the methodological implementation of the research, the following formula was used:



Where it is defined as follows:

M: Population to be investigated.
V1: Variable 1: Clinical simulation.
V2: Variable 2: Clinical competencies.
r: The value of the correlational coefficient between variables.

The first variable, "Clinical Simulation," involves the artificial replication of events designed to simulate reality in a controlled, safe, and reproducible manner, where participants interact in scenarios of varying complexity, facilitating collaborative professional competence development (PCD)[34, 35].

The proposed dimensions as a didactic instrument for the CS variable, based on the standards of the International Nursing Association for Clinical Simulation and Learning, were developed following the Cornerstones of Best Practice Program (CBPP). Four pillars of quality CS were considered: Prebriefing Dimension (pre-simulation information), Facilitation Dimension, Professional Integrity Session Dimension, and Debriefing Session Dimension[36].

The second variable was "Development of Professional Competencies," defined as the judicious use of knowledge, techniques, communication skills, clinical reasoning, emotional management, and values that benefit healthcare providers in solving problems of varying complexity[37, 38].

The development of the professional profile involves acquiring three aspects: "knowing," understood as careful and regulated knowledge, referred to as the Cognitive or Intellectual Domain; "knowing how to do," meaning the acquisition of psychomotor skills, referred to as the Procedural or Psychomotor Domain; and finally, "knowing how to be," which corresponds to attitudes and values. Refining these three characteristics establishes the professional competencies to be achieved[39].

The universe was defined as students officially enrolled in the medical program during 2024, while the study population consisted of 93 students from the eighth and ninth semesters of the medical program at a public university in Ecuador. These students participated in sessions to provide their opinions on SC (Clinical Simulation) in relation to DPC (Development of Professional Competencies)[40, 41].

The study technique was a survey, and the instruments used were two Likert-type questionnaires: one to evaluate SC and the other to evaluate DPC. These allowed the researchers to systematically investigate the stated problem[42]. Subsequently, the collected data was entered into Excel for tabulation and scoring. Then, SPSS 25 software was used for inferential analysis, normalization tests, and Spearman's rho correlation tests.

As a scientific endeavor to acquire new knowledge, the research was philosophically grounded in ethical conduct[43], adhering to values, codes, norms, and principles such as autonomy, non-maleficence, beneficence, and justice. The study also involved obtaining informed consent to prevent harm to third parties[44].

In this sense, the present study, titled "Impact of Clinical Simulation on the Comprehensive Development of Competencies in Medical Students," complied with ethical research standards, ensuring confidentiality, anonymity, and use solely for research purposes, with prior authorization from university authorities and informed consent from participants.

Results

Descriptive and Interpretive Analysis

Regarding students' perception of the use of clinical simulation strategies, it was found that 60% gave a high rating, perceiving it as effective in promoting active learning. However, 34% of respondents gave it a medium evaluation, indicating that there are some issues, such as lack of instructor preparation or insufficient institutional resources. Therefore, resources should be managed to allow for its proper implementation (see Table No. 1). These data are consistent with what is reported in the literature as positive but highlight deficiencies in resources, infrastructure, and training needed to maximize its benefits[45,46].

Table No. 1. Rating Scales for the Clinical Simulation Variable with Its Dimensions

	CLINICAL SIMULATION									
	PREBRIEFING		FACILITATION		INTEGRITY		DEBRIEFING		SIMULATION	
LEVELS	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
LOW	8	9 %	7	8 %	6	6 %	9	10 %	5	5 %
MEDIUM	40	43 %	28	30 %	33	35 %	23	25 %	32	34 %
HIGH	45	48 %	58	62 %	54	58 %	61	66 %	56	60 %
TOTAL	93	100 %	93	100 %	93	100 %	93	100 %	93	100 %

Source: Survey conducted with medical students
Prepared by: The authors

The respondents considered that the prior preparation (prebriefing) is adequate, but they pointed out that it needs to be improved; this is reflected in the parity between a high rating (48%) and a medium rating (43%); a result similar to studies that emphasize the importance of setting clear expectations and emotionally and cognitively preparing the participants [47].

Regarding the Facilitation dimension, 62% of students rated it at a high level, and 30% at a medium level, demonstrating that the instructor's participation during the simulation is necessary, and their interaction should be improved to optimize the learning experience, a result that aligns with literature highlighting their role as facilitators for meaningful learning [48].

The Debriefing phase was rated positively, with 66% at a high level and only 10% indicating a low level, highlighting the effectiveness of post-simulation reflection to consolidate learning and provide feedback [49]. Medium and low ratings suggest there is still room to optimize the debriefing technique, through continuous training of facilitators in feedback strategies [50].

Table No. 2. Scales of the Variable Professional Competence Development with its Dimensions.

	PROFESSIONAL COMPETENCIES							
	COGNITIVE		ATTITUDINAL		PROCEDURAL		COMPETENCIES	
LEVELS	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
LOW	3	3%	3	3%	3	3%	3	3%
MEDIUM	24	26%	16	17%	25	27%	20	22%
HIGH	66	71%	74	80%	65	70%	70	75%
TOTAL	93	100%	93	100%	93	100%	93	100%

Source: Survey conducted with medical students
Prepared by: The authors

The results of the variable Professional Competency Development document a very satisfactory evaluation, with 75% rating it as high level, which reflects a positive impact of simulation in strengthening competencies. However, there is still a significant group of respondents, 22%, with some level of dissatisfaction, rating the development of competencies at a medium level (see Table No. 2). This could suggest the existence of certain difficulties in perceiving the achievements made, possibly due to variability in the quality of the simulations or the insufficiency of practical sessions [51]; a review of regional research shows a similar trend in the perception of simulation effectiveness for competency development [52].

Table No. 3. Analysis of Normality Tests

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	gl	Sig.	Statistic	gl	Sig.
Evaluation of the First Variable Clinical Simulation	0,059	93	0,200*	0,965	93	0,014
Evaluation of the Second Variable Professional Competencies	0,138	93	0,000	0,902	93	0,000

* This is the lower bound of the true significance.
a. Lilliefors significance correction
Normality value 0.05

Source: Survey conducted with medical students
Prepared by: The authors
Given that the study sample consists of 93 students, the Kolmogorov-Smirnov normality test was used to verify whether the two study variables follow a normal distribution, i.e., to determine if the obtained values are concentrated around the mean. To do this, we set the null hypothesis as Ho = the entered data follows a normal distribution, and the alternative hypothesis as H1 = the entered data does not follow a normal distribution. The confidence level was set at 0.95, and α was set at 0.05 as the margin of error or significance level. For the statistical test, it was considered that if the p-value is < 0.05, we reject Ho and accept H1, meaning that the data does not follow a normal distribution. If the p-value is > 0.05, we accept Ho and reject H1, meaning we consider the data to follow a normal distribution (see Table N° 3).
Once these considerations were defined, we analyzed the first variable, clinical simulation strategies. Statistic 0.059; df 93; Sig 0.200; the normality p-value allowed us to identify that the p-value Sig 0.200, which is greater than 0.05, so we accept the null hypothesis and conclude that the data follows a normal distribution. When analyzing the second variable, development of professional competencies, we found that the p-value was Sig 0.000, which is less than 0.05. Therefore, we do not accept the null hypothesis and conclude that it does not follow a normal distribution. This means that the values of the dependent random variable do not follow a normal distribution in the population from which the sample was taken.
In this case, since variable 1 showed a normal distribution and variable 2 showed a non-normal distribution, we concluded that this implies variations in the perceptual homogeneity of the students. Since neither of the two variables follows a symmetric distribution, this difference in distributions may be due to the diversity in prior exposure to similar teaching methods or the context of the students. Therefore, we decided to use a non-parametric statistic, specifically the Spearman correlation test[53].

Table N° 4. Spearman Non-Parametric Correlation

		Evaluation of the First Variable: Clinical Simulation	Evaluation of the Second Variable: Professional Competencies
Evaluation of the First Variable: Clinical Simulation	Spearman's Rho Correlation Coefficient	1,000	0,641**
	Sig. (bilateral)	.	0,000
	N	93	93
Evaluation of the Second Variable: Professional Competencies	Correlation Coefficient	0,641**	1,000
	Sig. (bilateral)	0,000	.
	N	93	93

**. The correlation is significant at the 0.01 level (bilateral).

Source: Interpretative analysis of the results obtained in the Spearman correlation for the variables "Clinical Simulation" and "Professional Competencies" using SPSS 25

Prepared by: The authors

The Spearman correlation measures the degree of association between the two variables, with the null hypothesis H_0 = that there is no correlation between variables 1 and 2; and the alternative hypothesis H_1 = that there is a correlation between the two variables. The confidence level was set at 0.95 and α at 0.05 (margin of error). For the test statistic, it was considered that if the p-value is < 0.05, the null hypothesis is rejected, accepting H_1, meaning that a correlation exists, and if the p-value is > 0.05, the null hypothesis is accepted, rejecting H_1, meaning there is no correlation.

Once these considerations were defined for both variables, in the analysis of the Spearman Rho correlation coefficient 0.641** Sig. (bilateral) 0.000, i.e., a $p < 0.01$, N 93, we rejected the null hypothesis and accepted the alternative hypothesis, which allows establishing a significant correlation at the bilateral level; this provides evidence of a moderate-high positive correlation between the variables "Clinical Simulation Strategies" and "Development of Professional Competencies"; this means that as the perception of clinical simulation improves, the development of professional competencies also increases, implying a strong relationship, although not perfect, suggesting the need to address additional factors to maximize the simulation results [54].

Table No. 5. Interpretation of the Spearman's Rank Correlation Coefficient (Rho)

Very strong negative correlation	Strong negative correlation	Moderate negative correlation	Weak negative correlation	Very weak negative correlation	Very weak positive correlation	Weak positive correlation	Moderate positive correlation	Strong positive correlation	Very strong positive correlation

Very high	High	Moderate	Low	Very low	Very low	Low	Moderate	High	Very high

-1 -0,8 -0,6 -0,4 -0,2 0 +0,2 +0,4 +0,6 +0,8 +1

INVERSE DIRECT

The hypothesis test for the correlation of the variables 'simulation strategies' and 'clinical competencies development' used a non-parametric correlation test = Spearman's Rho coefficient, where it is observed that the value for both variables is 0.641. According to the correlation coefficient interpretation table, a strong positive correlation exists, indicating a high direct relationship (see Table No. 5).

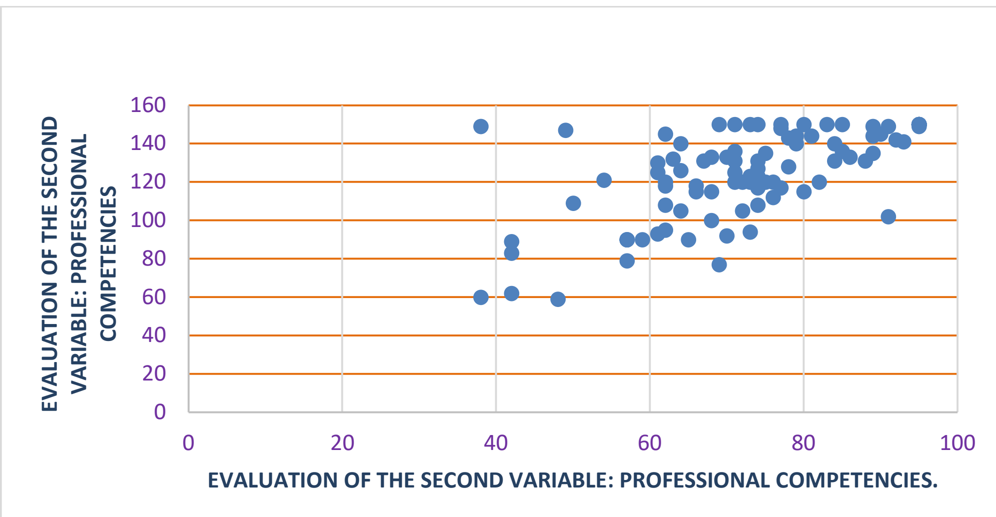


Figure No. 1. Correlation between the variables.
Source: SPSS 25
Prepared by: The authors.

Furthermore, since the Spearman correlation hypothesis test confirmed that there is a significant relationship ($p < 0.05$) between the variables Clinical Simulation Strategies and Professional Competencies Development, it confirms that clinical simulation strategies positively influence the development of competencies. Therefore, it should be considered a key curricular component, through careful planning and continuous improvement, ensuring that students can benefit equitably[55].

Discussion

The results obtained document the effectiveness of simulation strategies in professional training, aligning with recent literature and highlighting both the similarities and discrepancies with previous research, showing a positive impact on key competencies such as clinical decision-making, teamwork, and proficiency in medical procedures, fostering comprehensive learning compared to traditional education[56]. However, some aspects were perceived as average, reflecting challenges that require attention to maximize their effectiveness.

Both variables were mostly rated at a high level, confirming the positive impact of simulation in medical education[57]. This reinforces the need to integrate it into the curriculum, as it promotes active learning that improves the acquisition of practical skills in a safe environment, increases self-confidence, and enhances the retention of knowledge and research skills[58].

The Kolmogorov-Smirnov normality test revealed differences in the distribution of the variables, justifying the use of non-parametric statistical tests, ensuring the validity of the results[59].

The Prebriefing dimension was rated at a high level, highlighting its importance in preparing students emotionally and cognitively, although the average ratings suggest improving communication and expectations during this phase[60].

The Facilitation dimension, recognized as key for guiding reflective and critical learning, was mostly rated high, but with indications of the need for formative improvement and standardization to optimize its effectiveness[61].

The Debriefing was categorized as one of the most effective phases, with a high rating level, standing out for consolidating learning and promoting self-assessment, in line with previous studies[62].

A moderate-high positive correlation ($p < 0.001$) was confirmed between clinical simulation and competency development, with high-fidelity simulations and advanced technologies being highlighted as tools that promote comprehensive learning, consistent with research by Cant and Cooper[63].

Study limitations include a small sample size, a cross-sectional design that prevents the evaluation of competency evolution, uncontrolled factors such as students' prior experience, and biases from self-perception that may influence the assessment of strategies.

Recommendations

Due to all these factors, the following suggestions are made:

1. Clinical Simulation Program: Implement a clinical simulation program that applies continuous improvements with feedback.
2. Standardization of Methods Applied in Simulation: A consensus should be promoted on the evaluation protocols in clinical simulation to ensure the comparability of results and their replication.
3. Instructor Training: Ensure that instructors are adequately trained in the implementation and facilitation of complex simulations.
4. Technological Integration: Implement advanced technologies to simulate high-complexity situations.
5. Individual Evaluation of Participants: This suggests the need for longitudinal and multicenter studies to assess the evolution of competency development over time and reduce biases.
6. Encourage Research: Conduct long-term longitudinal studies to evaluate the sustained impact in different educational contexts, refining clinical simulation strategies and maximizing medical education, ensuring that students acquire the necessary competencies for successful and safe professional practice.

References

1. Adnan S, Xiao J. A scoping review on the trends of digital anatomy education. Clinical Anatomy, [Internet]. 2023;36(3):471–491. Available: https://doi.org/https://doi.org/10.1002/ca.23995
2. Rivadeneira-Paz LH, Jama-Zambrano VR. Los estilos de aprendizaje para potenciar competencias operacionales cognitivas. Dominio Las Ciencias [Internet]. 2024;10(3): 135-155. Available: https://dominiodelasciencias.com/ojs/index.php/es/article/view/3921
3. Veliz-Rojas L, Zuleta-González L, & Bianchetti-Saavedra A. Simulación como estrategia de desarrollo de competencias culturales en estudiantes del área de la salud. Revista Educación Médica Superior (impresa) [Internet]. 01 diciembre 2021;35(4):1–28. Available http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-21412021000400011
4. Jans C, Bogossian F, Andersen P, Levett-Jones T. Examining the impact of virtual reality on clinical decision making – An integrative review. Nurse Education Today, [Internet]. Jun 2023;125, 105767. Doi: https://doi.org/https://doi.org/10.1016/j.nedt.2023.105767
5. Rubiano-Arévalo DA. Perspectivas ontológicas en el conocimiento profesional del profesor de química: una revisión de antecedentes desde las categorías OEQ y CPPQO. Revistas Venezolanas de Ciencia y

Tecnología REVENCYT [Internet]. 23 nov 2022;59:54–72. Available: https://revista.grupocieg.org/wp-content/uploads/2022/12/Ed.5954-72-Rubiano-Daniel.pdf

6. Huang Q, Yan SY, Huang J. et al. Effectiveness of simulation-based clinical research curriculum for undergraduate medical students - a pre-post intervention study with external control. BMC Medical Education [Internet]. May 2024;24:542 Available: https://doi.org/10.1186/s12909-024-05455-6

7. INACSL Standards Committee. INACSL standards of best practice: SimulationSM. Simulation design. Clinical Simulation in Nursing [Internet]. 2016;12(S):S5-S12. Available: https://www.nursingsimulation.org/action/showPdf?pii=S1876-1399%2816%2930126-8

8. Motola I, et al. Simulation in Healthcare Education: A Best Evidence Practical Guide. AMEE Guide No. 82. Revista Medical Teacher [Internet]. August 2013;35(10):e1511-e1530. Available: https://doi.org/10.3109/0142159X.2013.818632

9. Elendu C, Amaechi DC, Okatta AU, et al. The impact of simulation-based training in medical education: A review. Medicine (Baltimore). [Internet]. 5 Jul 2024;103(27):e38813. Available: https://doi.org/10.1097/MD.0000000000038813

10. Archana S, Nilakantam SR, Hathur B, Dayananda M. The need and art of establishing skill and simulation centers to strengthen skill-based medical education: Learning insights and experience. Ann Afr Med [Internet]. 2021;20(4):247-254. Available: https://doi.org/10.4103/aam.aam_53_20

11. Iakovos T, Marios N, Thanos A, et al. Simulation-Based Learning Strategies to Teach Undergraduate Students Basic Surgical Skills: A Systematic Review, Journal of Surgical Education, [Internet]. 2018. 75(5);1374-1388. Available: https://doi.org/10.1016/j.jsurg.2018.01.013

12. Kim J, Park JH, Shin S. Effectiveness of simulation-based nursing education depending on fidelity: a meta-analysis. BMC Medical Education. [Internet]. May 2016;16:152. Available: https://doi.org/10.1186/s12909-016-0672-7

13. Meneses-Castaño CY, Jimenez-Becerra I, Penagos-Gomez PT. Technology-mediated clinical simulation: A didactic based on resources for the training of rehabilitation professionals. Educación Médica [Internet]. August 2023;24(4):100810. Available: https://doi.org/https://doi.org/10.1016/j.edumed.2023.100810

14. Rodríguez S, et al. Implementación de Escenarios Clínicos Complejos Mediante Simulación Clínica en la Formación de Residentes de Pediatría en un Hospital Universitario en México. Ciencia Latina Internacional [Internet]. Octubre 2024;8(5):3647-3662. Available: https://doi.org/10.37811/cl_rcm.v8i5

15. Zapata-Giraldo PC, Acevedo-Osorio GO. Challenges and perspectives of educational systems in latin america: A comparative analysis. Pedagogical Constellations [Internet]. 2024 [cited 2024 nov. 19];3(1):89-101. Available: https://pedagogicalconstellations.com/index.php/home/article/view/28

16. Langerfeldt, E.F. & Caballero-Muñoz, E. (2013). SLD144 Implementación de la Simulación Clínica en una Facultad de Ciencias de la Salud. IX Congreso Internacional Informática en Salud. 1-6. Available: http://www.informatica2013.sld.cu/index.php/informaticasalud/2013/paper/viewFile/307/54

17. Shibao-Miyasato H, Armijo-Rivera S, Casas-Bueno F, Sandoval-Barrantes AM, Delgado-Guevara X, Gutiérrez-Díaz M, et al. Evaluation of a course for simulation instructors at a Peruvian university. Salud, Ciencia y Tecnología - Serie de Conferencias [Internet]. 2023 oct. 4 [cited 2024 nov. 20]; 2:429. Doi: https://doi.org/10.56294/sctconf2023429

18. SUNEDU. Modelo de Renovación de Licencia Institucional. Superintendencia Nacional de Educación Superior Universitaria. Resolución de Consejo Directivo N° 091-2021-SUNEDU/CD [Internet]. 2021. Available: https://cdn.www.gob.pe/uploads/document/file/2151022/Modelo.pdf?v=1630646546

19. Coyne E, Calleja P, Forster E, Lin F. A review of virtual-simulation for assessing healthcare students'

clinical competency. Nurse Education Today [Internet]. Jan 2021;96:104623. Available: https://doi.org/https://doi.org/10.1016/j.nedt.2020.104623
20. González-Peñafiel A, Bravo-Zúñiga B, Ortiz-González M. Learning based on simulation and the contribution of educational theories. Revista Espacios. [Internet]. Feb. 2018;39(20):37. Available: https://www.revistaespacios.com/a18v39n20/a18v39n20p37.pdf
21. Álvarez-Ríos JN, Erazo-Martínez OF. Simulación clínica y la modelización didáctica en ciencias para la salud. Educación Médica [Internet]. 25 (2024);100922. Available: https://doi.org/10.1016/j.edumed.2024.100922
22. Nagarajappa A, Kaur S. Simulation in contemporary medical education: Current practices and the way forward. Indian Journal Anaesthesia [Internet]. 18 January 2024;68(1):17-23. Available: https://doi.org/10.4103/ija.ija_1203_23
23. Amrein GR, Bertran PB, et al. Clinical simulation in medical education. Advantages and disadvantages of learning at the patient's side and in a simulated environment [Internet]. December 2024;7(4):100459. Available: https://doi.org/10.1016/j.mcpsp.2024.100459
24. Flores-Fiallos SL. Simulación clínica en la formación de profesionales de la salud: explorando beneficios y desafíos. Vitalia [Internet]. 9 de mayo de 2024;5(2):116-129. Available: https://doi.org/10.61368/r.s.d.h.v5i2.124
25. Cant RP, Cooper SJ. Use of simulation-based learning in undergraduate nurse education: An umbrella systematic review. Nurse Education Today [Internet]. February 2017;49:63-71. Available: https://doi.org/10.1016/j.nedt.2016.11.015
26. Fuentes-Galvez LM. Efectividad del entrenamiento simulado en estudiantes de enfermería: Una revisión bibliográfica. ACC CIETNA. [Internet]. 24 Julio 2024;11(1):e1009. Available: https://doi.org/10.35383/cietna.v11i1.1009
27. Pachuco-Flores AP, Chipantiza-Córdova TE, López-Pérez GP, Manzano- Quisimalin DE, Cajamarca-Chicaiza KM. Desarrollo de habilidades no técnicas en simulación para el proceso de formación de enfermería. LATAM. [Internet]. [Acceso 23/08/2023]. Available: https://doi.org/10.56712/latam.v4i2.1024
28. Leiphrakpam PD, Are C. Competency-Based Medical Education (CBME): an Overview and Relevance to the Education of Future Surgical Oncologists. Indian Journal Surgical Oncology [Internet]. 7 Mar 2023;1-11. Available: https://doi.org/10.1007/s13193-023-01716-w
29. Ravat, Z. What impact can simulations have in advancing medicine? Cambridge Medicine Journal [Internet]. 03 August 2021. Available: https://doi.org/10.7244/cmj.2021.08.001
30. Riley RH, Graafland M, Schijven MP. The role of simulation in surgical training and certification. Current Surgery Reports [Internet]. 2021;9(4):158-166. Available: https://doi.org/10.1007/s40137-021-00265-4
31. González-Peñafiel A, Bravo-Zúñiga B, Ortiz-González M. Learning based on simulation and the contribution of educational theories. Revista Espacios. [Internet]. Feb. 2018;39(20):37. Available: https://www.revistaespacios.com/a18v39n20/a18v39n20p37.pdf
32. Sánchez H, Reyes C, Mejía K. Manual de términos de investigación científica, tecnológica y humanística. Perú: Universidad Ricardo Palma. Primera edición. [Internet]. Junio 2018. Available: https://repositorio.urp.edu.pe/handle/20.500.14138/1480
33. Hernández-Sampieri R, Mendoza-Torres CP. Metodología de la Investigación. Las rutas cuantitativa, cualitativa y mixta. Ciudad de México, México: Editorial Mc Graw Hill Education. Primera Edición [Internet]. 2018; 1-753. Available: https://www.academia.edu/43982331/METODOLOG%C3%8DA_DE_LA_INVESTIGACI%C3%93N_L

AS_RUTAS_CUANTITATIVA_CUALITATIVA_Y_MIXTA
34. Concytec. Guía práctica para la: Identificación, Categorización, Priorización y Evaluación de Líneas de Investigación. Consejo Nacional de Ciencia Tecnología e Innovación Tecnológica [Internet]. 2019; 1-12. Available: https://portal.concytec.gob.pe/images/publicaciones/guias-doc/guia_practica_identificacion_categorizacion_priorizacion_evaluacion_lineas_investigacion.pdf
35. Nnaemeka-Ajemba M, Ikwe C, Chioma-Iroanya J. Effectiveness of simulation-based training in medical education: Assessing the impact of simulation-based training on clinical skills acquisition and retention: A systematic review. WJARR World Journal of Advanced Research and Reviews. [Internet]. January 2024;21(01):1833-1843. Available: https://doi.org/10.30574/wjarr.2024.21.1.0163
36. Duff JP, Morse KJ, Seelandt J, et al. Debriefing Methods for Simulation in Healthcare: A Systematic Review. Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare [Internet]. January 2024;19(1S):S112-S121. Available: https://doi.org/10.1097/SIH.0000000000000765
37. Castillo-Flamain C. Competencias profesionales en medicina. Metro Ciencia [Internet]. Octubre 2021 [Acceso 23/10/2023];29(4):73-81. Available: https://doi.org/10.47464/MetroCiencia/vol29/4/2021/73-81
38. Nair MA, Muthu P, Abuijlan IAM. The Effectiveness of High-Fidelity Simulation on Clinical Competence Among Nursing Students. SAGE Open Nursing [Internet]. 2024 May 6;10:23779608241249357. Available: https://doi.org/10.1177/23779608241249357
39. Zhang G, Hongbin W, A'Na X, Cheng H. The Association between Medical Student Research Engagement with Learning Outcomes. Medical Education Online [Internet]. Jul 2022;27(1):2100039. Available: https://doi.org/10.1080/10872981.2022.2100039
40. Alan-Neill D, Cortez-Suárez L. Procesos y fundamentos de la investigación científica. REDES [Internet]. 2017 [Acceso 8/07/2024];cap.4:1-127. Available: https://repositorio.utmachala.edu.ec/bitstream/48000/12498/1/Procesos-y-FundamentosDeLainvestiagcionCientifica.pdf
41. Ocampo-Mallou C, Delvitto A, Di-Pasquo F. Discusiones sobre el concepto de población humana en la investigación epidemiológica del dengue en Argentina. Revista colombiana de filosofía de la ciencia [Internet]. 30 Junio 2022;22(44):169-211. Available: https://doi.org/10.18270/rcfc.v22i44.3486
42. Cabezas-Mejía ED, Andrade-Naranjo D, Torres-Santamaría J. Introducción a la investigación científica. Universidad de las Fuerzas Armadas ESPE. Primera edición [Internet]. Octubre 2018. Available: https://repositorio.espe.edu.ec/bitstream/21000/15424/1/Introduccion%20a%20la%20Metodologia%20de%20la%20investigacion%20cientifica.pdf
43. Ojeda de López J, Quintero J, Machado I. La ética en la investigación. Telos Revista de estudios Interdisciplinarios en Ciencias Sociales [Internet]. Agosto 2007;9(2):345-357. Disponible en: http://www.redalyc.org/src/inicio/ArtPdfRed.jsp?iCve=99318750010
44. Orozco H, Lamberto J. La ética en la investigación científica: consideraciones desde el área educativa. Perspectivas: Revista de Historia, Geografía, Arte y Cultura [Internet]. 2022;10(19):11-21. Available: https://gc.scalahed.com/recursos/files/r161r/w26118w/La%20Etica%20en%20la%20investigaci_%B3n%20cientifica.pdf
45. Pabón-Guevara GC. Competencias cognitivas, procedimentales y actitudinales en ciencias naturales de los estudiantes de grado 4to y 5to de primaria: The cognitive, procedural and attitudinal skills in natural sciences of students in the 4to and 5to grades. merito [Internet]. 1 de mayo de 2021 [citado 20 de noviembre de 2024];3(8):115-29. Available: https://revistamerito.org/index.php/merito/article/view/594
46. Aranzamendi-Paredes R, Luque-Chipana NA, Taypicahuana-Juarez CM, Barreda-Tamayo HS. Acreditación de los centros de simulación clínica en el Perú. Revista Cubana de Medicina Militar. [Internet].

2021 Mar [citado 2024 Nov 20];50(1). Available: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0138-65572021000100033&lng=es

47. Maestre JM, et al. A practical guide to online debriefing: A scoping review and analysis of distance-based simulation programs. Educación Médica [Internet]. December 2021;22(6):330–339. Available: https://doi.org/https://doi.org/10.1016/j.edumed.2021.07.002

48. Maia D, Andrade R, Afonso J, Costa P, Valente C, Espregueira-Mendes J. Academic Performance and Perceptions of Undergraduate Medical Students in Case-Based Learning Compared to Other Teaching Strategies: A Systematic Review with Meta-Analysis. Education Sciences [Internet]. February 2023;13(3): 238. Available: https://doi.org/10.3390/educsci13030238

49. Moncada-Augusto GR, Rodríguez VI, Fernández-Andrea VCL, Terán AJ La Simulación como Herramienta de Enseñanza y Aprendizaje Quirúrgico. Revista Venezolana de Cirugía. [Internet]. Dic 2023. [citado 2024 Nov 20];76(2):120-125. Available: https://doi.org/10.48104/rvc.2023.76.2.14

50. Sun W, Jiang X, Dong X, Yu G, Feng Z, Shuai L. The evolution of simulation-based medical education research: From traditional to virtual simulations. Heliyon [Internet]. 15 August 2024;10(15):e35627. Available: https://doi.org/10.1016/j.heliyon.2024.e35627

51. Illesca-Pretty M., Novoa-Moreno R, Cabezas-González M, Hernández-Díaz A, González-Osorio L. Simulación Clínica: Opinión de Estudiantes de Enfermería, Universidad Autónoma de Chile, Temuco. Enfermería: Cuidados Humanizados [Internet]. 2019;8(2):51–65. Available: https://doi.org/https://doi.org/10.22235/ech.v8i2.1845

52. Martínez-Castillo F, Matus-Miranda R. Desarrollo de habilidades con simulación clínica de alta fidelidad. Perspectiva de los estudiantes de enfermería. Enfermería Universitaria, [Internet]. 29 mayo 2015;12(2):93–98. Available: https://doi.org/https://doi.org/10.1016/j.reu.2015.04.003

53. Issenberg SB, McGaghie WC, Petrusa ER, Gordon DL, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review. Medical Teacher [Internet]. 2005;27(1):10-28. Available: https://doi.org/10.1111/medu.14789

54. Diaz-Navarro C, Armstrong R, Charnetski M, Freeman JK, Koh S, Reedy G, et al. Global consensus statement on simulation-based practice in healthcare. Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare [Internet]. June 2024;19(3):e52-e59. Available: https://doi.org/10.1097/SIH.0000000000000804
https://journals.lww.com/simulationinhealthcare/fulltext/9900/global_consensus_statement_on_simulation_based.123.aspx

55. Rakhi M, Hemlata DT. Simulation-based learning in nursing curriculum- time to prepare quality nurses: A systematic review and meta-analysis Heliyon [Internet]. May 2023;9(5):e16014. Available: https://doi.org/10.1016/j.heliyon.2023.e16014
https://www.sciencedirect.com/science/article/pii/S2405844023032218

56. Jaramillo RN, LiezlMae GM, Bucao TP, Bueno BJ, Bulatao LR, Cabrera S, et al. A SYSTEMATIC REVIEW OF SIMULATION-BASED LEARNING VERSUS TRADITIONAL LEARNING. Cosmos An International Journal of Art & Higher Education A Refereed Research Journal [Internet]. 2024;11(2):24-28. Available: https://acspublisher.com/journals/index.php/cijahe/article/view/12958

57. Zapata-Ospina JP, Zamudio-Burbano MA. Razonamiento clínico en medicina II: hacia una definición integradora. Revista Iatreia [Internet]. Oct-Dic 2021;34(4):325-334. Available: https://www.redalyc.org/journal/1805/180569430005/html/

58. Tamayo M, Tamayo. El proceso de la investigación científica. Editorial Limusa. Cuarta edición [Internet]. 2004. Available: https://pubhtml5.com/rsfn/qpbh/basic/

59. Cleland JA, Durning SJ, Driessen E. Medical education research: Aligningdesign and Research Goals. The Medical Journal of Australia MJA [Internet]. Jun 2018;28(11):473-475. Available: https://doi.org/10.5694/mja17.00941 https://onlinelibrary.wiley.com/doi/10.5694/mja17.00941
60. Wiener RL, Erker PV. The Effects of Prebriefing Misinformed Research Participants on Their Attributions of Responsibility, The Journal of Psychology: Interdisciplinary and Applied [Internet]. 2010;120(4):397-410. Available: https://doi.org/10.1080/00223980.1986.9712638
61. Wong AH, Ruppel H, Gang M, Ng, G. "The Safety Dance": A Faculty Development Workshop Partnering IPE and Patient Safety Initiatives Using Simulation-Based Education. MedEdPORTAL: the journal of teaching and learning resources [Internet]. August 26, 2016;12:10440. Available: https://doi.org/10.15766/mep_2374-8265.10440 https://www.mededportal.org/doi/10.15766/mep_2374-8265.10440
62. Abulebda K, Auerbach M, Limaiem F. Debriefing Techniques Utilized in Medical Simulation In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Sep 26. Available: https://pubmed.ncbi.nlm.nih.gov/31536266/ https://www.ncbi.nlm.nih.gov/books/NBK546660/
63. Meyers L, Mahoney B, Schaffernocker T, Way D, Winfield S, Uribe A, et al. The effect of supplemental high Fidelity simulation training in medical students. Meyers et al. BMC Medical Education [Internet]. 2020;20:421. Available: https://doi.org/10.1186/s12909-020-02322-y https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-020-02322-y