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Article

Nursing Competence in Simulation-Based Education: Predictors of Perceived Comprehensiveness in Colombian Undergraduate Health Programs

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Abstract

Background: Clinical simulation is pivotal for developing nursing competence, yet the predictors of perceived comprehensiveness among students remain underdescribed in multidisciplinary contexts. **Methods:** Cross-sectional study of 926 students from eight health programs at a Colombian higher-education institution. A validated questionnaire (benefits, contributions, and academic complement) was used, and the association with perceived comprehensiveness was modelled using multivariable regression. **Results:** 90.9% rated simulation as comprehensive. The “contributions” domain—especially reinforcement of theoretical knowledge and clinical reasoning—was the strongest predictor (adjusted effect estimate $\approx$ 4.59, 95% CI 2.41–8.72). Higher agreement was also observed among women, rural residents, single students, and those in advanced semesters. Comparatively lower-scoring items pointed to realism in decision-making and protected time. **Conclusions:** From a nursing perspective, perceived comprehensiveness depends primarily on the educational value that strengthens clinical reasoning and theory-to-practice integration—core components of competence frameworks (e.g., QSEN, Jeffries). Enhancing fidelity, decision-making scenarios, and protected time may accelerate competence attainment and promote equity among students with limited clinical exposure.

Keywords: nursing competence; competency-based education; clinical reasoning; simulation fidelity; decision-making; QSEN; Jeffries simulation theory; Colombia

1. Introduction

In health sciences education, preparing future professionals to meet the complex demands of the 21st century requires the integration of theoretical knowledge, practical competencies, and critical thinking skills [1]. The lecture model has traditionally dominated health pedagogy, where the educator transmits knowledge through unidirectional presentations, relegating students to a passive role in their learning process [2,3]. This approach even in clinical skills training, has limited student engagement and contributed to safety incidents due to insufficient hands-on experience

The abrupt transition from passive learning to an active model has proven problematic, as evidenced by the incidence of accidents among health students, often attributed to insufficient practical experience [4,5]. The need for solid theoretical-practical training is crucial to minimize the occurrence of adverse events [6]. In current literature, education is described as a social process that involves cultural conservation, transmission, assimilation, and transformation, observed through a constructivist approach that values the learner’s previous experiences and how these influence the interpretation and future exploration of concepts in various areas [1,2]

Given this scenario, higher education institutions, together with educators and students, must recognize the importance of implementing innovative teaching methodologies that improve the assimilation and application of knowledge, thus ensuring the training of competent professionals in the field of health [7–11]

In this context, clinical simulation has been consolidated as an essential pedagogical tool within the academic curriculum. This approach not only aligns with the principles of constructivism, placing the student at the center of the educational process and allowing him to build his learning through the active experimentation of clinical situations but also encourages the development of problem-solving skills through its execution [1,2,12–18]. Although clinical simulation is widely adopted in health education, empirical research on students' perception of its comprehensiveness remains limited—particularly in multidisciplinary programs beyond nursing and medicine [24,26,27]. Moreover, few studies have applied multivariate models to identify predictors such as sociodemographic traits or perceived educational value [21,24,29,30]. This study addresses this gap by including students from eight health science programs and using a log-binomial regression model to explore the factors associated with perceived comprehensiveness.

Therefore, the present study aims to evaluate health sciences students' perceptions of clinical simulation within a Higher Education Institution (H.E.I.) in Colombia. Specifically, it seeks to identify the factors that best predict students' perception of the comprehensiveness of simulation-based learning, providing evidence to guide the future design and implementation of simulation programs in health education.

2. Materials and Methods

2.1. Study Design

A descriptive, observational, cross-sectional study was conducted to assess the perception of students enrolled in a Faculty of Health at a Higher Education Institution (H.E.I.) in Colombia, regarding the use of the Simulated Hospital as a learning tool. This methodological approach allowed obtaining detailed information on the variables of interest at a specific time.

2.2. Variables

The variables of the study were:

Independent variables: students' sociodemographic characteristics, level of benefits, level of contribution, and level of academic supplement of the Simulated Hospital.

Dependent variable: "Integrity of the Simulated Hospital," constructed from the benefits, contribution, and academic complement modules of the Simulated Hospital.

2.3. Population and Sampling

The target population consisted of undergraduate students enrolled in the following academic programs: nursing, medicine, physiotherapy, surgical instrumentation, dentistry, psychology, speech therapy, and respiratory therapy. All participants had attended clinical training sessions within the Simulated Hospital during the 2022 academic year at Cali, in Colombia.

A simple random sampling strategy was adopted. The sample size was calculated based on a 95% confidence level, an expected prevalence of 50%, and a margin of error of 5%, yielding a minimum sample of 940 students.

2.3.1. Inclusion and Exclusion Criteria

Students were eligible for inclusion if they were enrolled in one of the undergraduate health science programs listed above and had attended at least two clinical simulation sessions, accumulating a minimum of six practical hours. Additional inclusion criteria included valid academic registration, provision of informed consent, and regular attendance at simulation sessions according to the institutional schedule.

Students were excluded if they had participated in fewer than two simulation sessions or accumulated less than six hours of practical experience. Further exclusion criteria included withdrawal of consent after enrolment and incomplete or missing responses in the perception questionnaire.

2.4. Instrument

A structured questionnaire was developed to collect data on both sociodemographic characteristics and student's perception of the Simulated Hospital experience. The perception component was organized into three domains: perceived benefits, perceived contribution and perceived academic complement. Each of the -- items ws rated using a 5-point Likert scale (from 1 "strongly disagree" to 5 "strongly agree). The instrument was validated through a pilot test, which involved a small group representative of the target population. Based on the feedback received, minor adjustments were made to improve clarity, internal consistency, and content coverage prior to the final administration.

2.5 Data collection

Data were collected using Google Forms and exported to Microsoft Excel® 2010 for processing and organization. During this stage, quality control procedures were applied to ensure data completeness and consistency. Records with missing values, inconsistencies, or non-compliance with inclusion criteria were excluded from analysis.

2.6. Data Analysis

A descriptive analysis was performed to summarize the sociodemographic profile of participants, using absolute and relative frequencies. To examine associations between sociodemographic characteristics and perception domains (benefits, contributions, academic complement), contingency tables were constructed and statistical significance was assessed using chi-square tests or Fisher's exact test, as appropriate based on cell frequencies.

Subsequently, a log-binomial regression model was fitted to identify predictors of the perceived comprehensiveness of the "Integrity of the Simulated Hospital" [19,20]. The model included all independent variables (age, sex, marital status, academic semester, residence, and perception domains). Model performance and goodness-of-fit were evaluated using the omnibus test, Nagelkerke's R^2 , and the overall classification accuracy (sensitivity, specificity, and correct classification rate). Statistical significance was defined as $p < 0.05$.

3. Results

Most study participants were young, single women between 20 and 24, enrolled in advanced semesters of various health science programs at the H.E.I. Most students lived in urban areas, and only a minority declared belonging to specific population groups, such as Afro-Colombian, indigenous people, or victims of Colombia's armed conflict. The perceived benefits of clinical simulation were rated positively by the participants, with 91.1% overall satisfaction and individual item scores exceeding 85%. The item with the lowest agreement (85.2%) was: "There are differences between the procedures performed in the simulation and real practice". In contrast, the highest-rated item (90.4%) was: "The procedures performed in the simulation provide skills for the implementation of procedures in real clinical settings". No statistically significant associations were found between sociodemographic variables and the perceived benefits ($p > 0.05$) (see Table 1).

In the "Contribution to Practice" domain, all items reported satisfaction levels above 85%, with an overall mean of 90.4%. The lowest-rated statement was: "The simulation experience provided elements for clinical decision-making" (85.5%), while the most highly rated item was: "The simulated practice reinforced theoretical and conceptual aspects relevant to clinical performance" (92.5%). Higher satisfaction levels were observed among female students aged 20–24, residing in rural areas, attending advanced semesters (sixth and beyond), and with single marital status. Statistically

significant associations were identified for academic semester and marital status ($p < 0.05$) (see Table 1).

Regarding the academic complement dimension, students expressed an overall satisfaction rate of 90.8%, with all item scores above 83%. The lowest-rated item was: “The time allocated for simulation is appropriate for the type of practice” (83.4%). Conversely, the highest-rated statement was: “During simulations and labs, clear explanations are provided about the rules and operation of the Simulated Hospital” (91.1%). Higher appreciation was noted among male students aged 20–24, living in rural areas, in advanced semesters, and single, although no significant associations were detected ($p > 0.05$) (see Table 1).

Table 1. Level of benefits, contribution, and academic complement of the practice in the simulated hospital of a Faculty of Health in an I.E.S., in Cali Colombia, 2022.

Sociodemographic factors		Level of benefits of the simulated hospital for clinical practices										P value	
		Strongly disagree		Somewh at disagree		Neither agree nor disagree		Somewh at agreed		I agree		Total	
		n	(%)	N	(%)	n	(%)	n	(%)	N	(%)	n	(%)
Age group (years)	17 to 19	1	0.6	2	1.1	14	7.8	65	36.3	97	54.2	179	19.3
	20 to 24	6	1.2	8	1.5	29	5.6	196	37.9	278	53.8	517	55.8
	25 and over	2	0.9	6	2.6	14	6.1	91	39.6	117	50.9	230	24.8
Sex	Male	2	1.3	2	1.3	12	7.6	58	36.9	83	52.9	157	17.0
	Female	7	0.9	14	1.8	45	5.9	294	38.2	409	53.2	769	83.0
Residence	Urban	8	1	13	1.6	54	6.8	296	37.2	424	53.3	795	85.9
	Rural	1	0.8	3	23	3	23	56	42.7	68	51.9	131	14.1
Semester	1 to 5	5	1,2	9	2.2	30	7.4	155	38.3	206	50.9	405	43.7
	6 to 12	4	0.8	7	1.3	27	5.2	197	37.8	286	54.9	521	56.3
Marital status	Single	8	1	11	1.3	49	6	311	38.0	440	53.7	819	88.4
	With a partner	1	0.9	5	4.7	8	7.5	41	38.3	52	48.6	107	11.6
Total		9	1.0	16	1.7	57	6.2	352	38.0	492	53.1	926	100

Sociodemographic factors		Level of contribution of the simulated hospital for clinical practices										p value chi-square	
		Strongly disagree		Somewh at disagree		Neither agree nor disagree		Somewh at agreed		I agree		Total	
		n	(%)	N	(%)	n	(%)	n	(%)	N	(%)	n	(%)
Age group (years)	17 to 19	1	0.6	2	1.1	16	8.9	50	27.9	110	61.5	179	19.3
	20 to 24	3	0.6	5	1	40	7.7	163	31.5	306	59.2	517	55.8
	25 and over	1	0.4	7	3	14	6.1	71	30.9	137	59.6	230	24.8
Sex	Male	1	0.6	5	3.2	11	7	49	31.2	91	58	157	17.0

	Female	4	0.5	9	1,2	59	7.7	235	30.6	462	60.1	769	83.0	
Residence	Urban	5	0.6	12	1.5	63	7.9	244	30.7	471	59.2	795	85.9	0.731
	Rural	0	0	2	1.5	7	5.3	40	30.5	82	62.6	131	14.1	
Semester	1 to 5	2	0.5	11	2.7	41	10.1	114	28.1	237	58.5	405	43.7	0.005*
	6 to 12	3	0.6	3	0.6	29	5.6	170	32.6	316	60.7	521	56.3	
Marital status	Single	5	0.6	7	0.9	63	7.7	256	31.3	488	59.6	819	88.4	0.0001*
	With a partner	0	0	7	6.5	7	6.5	28	26.2	65	60.7	107	11.6	
Total		5	0.5	14	1.5	70	7.6	284	30.7	553	60	926		

Sociodemographic factors		Academic complement level of the simulated hospital for clinical practices												P value chi-square
		Strongly disagree		Somewh at disagree		Neither agree nor disagree		Somewh at agreed		I agree		I agree		
		n	(%)	n	(%)	n	(%)	n	(%)	N	(%)	n	(%)	
Age group (years)	17 to 19	1	0.6	2	1.1	14	7.8	60	33.5	102	57	179	19.3	0.986
	20 to 24	3	0.6	9	1.7	33	6.4	178	34.4	294	56.9	517	55.8	
	25 and over	1	0.4	3	1.3	19	8.3	73	31.7	134	58.3	230	24.8	
Sex	Male	0	0	5	3.2	8	5.1	56	35.7	88	56.1	157	17.0	0.206
	Female	5	0.7	9	1,2	58	7.5	255	33.2	442	57.5	769	83.0	
Residenc e	Urban	5	0.6	12	1.5	59	7.4	267	33.6	452	56.9	795	85.9	0.801
	Rural	0	0	2	1.5	7	5.3	44	33.6	78	59.5	131	14.1	
Semester	1 to 5	2	0.5	8	2	35	8.6	127	31.4	233	57.5	405	43.7	0.35
	6 to 12	3	0.6	6	1,2	31	6	184	35.3	297	57	521	56.3	
Marital status	Single	5	0.6	12	1.5	52	6.3	279	34.1	471	57.5	819	88.4	0.118
	With a partner	0	0	2	1.9	14	13.1	32	29.9	59	55.1	107	11.6	
Total		5	0.5	14	1.5	66	7.1	311	33.6	530	57.2	926	100	

Source: Own elaboration.

The association analyses between the levels of perceived benefits, contribution, and academic supplementation and students’ sociodemographic characteristics revealed certain trends; however, no statistically significant associations were observed ($p > 0.05$).

With respect to the perceived comprehensiveness of the simulated hospital experience for clinical practice, 90.9% of students rated the experience as comprehensive. Higher agreement levels were noted among students aged 17 to 19, female, residing in rural areas, attending advanced semesters (sixth or higher), and those with single marital status. Nevertheless, none of these associations reached statistical significance ($p > 0.05$) (Table 2).

Table 2. The comprehensiveness of the simulated hospital for clinical practices against the sociodemographic factors of a Faculty of Health in an H.E.I., in Cali Colombia, 2022.

Sociodemographic factors		Overall Rating (Integrity)										P value chi-square
		Strongly disagree		Somewhat disagree		Neither agree nor disagree		Somewhat agreed		I agree		
		N	(%)	n	(%)	n	(%)	N	(%)	n	(%)	
Age group	17 to 19 years old	1	0.6	1	0.6	13	7.3	64	35.8	100	55.9	0.927
	20 to 24 years	3	0.6	9	1.7	34	6.6	194	37.5	277	53.6	
	25 years and older	1	0.4	6	2.6	14	6.1	88	38.3	121	52.6	
Sex	Male	1	0.6	5	3.2	8	5.1	59	37.6	84	53.5	0.558
	Female	4	0.5	11	1.4	53	6.9	287	37.3	414	53.8	
Residence	Urban	5	0.6	13	1.6	56	7.0	294	37.0	427	53.7	0.540
	Rural	0	0.0	3	23	5	3.8	52	39.7	71	54.2	
Semester	First to fifth	2	0.5	11	2.7	32	7.9	145	35.8	215	53.1	0.164
	Sixth grade to boarding school	3	0.6	5	1.0	29	5.6	201	38.6	283	54.3	
Marital status	Single	5	0.6	11	1.3	51	6.2	309	37.7	443	54.1	0.075
	With a partner	0	0.0	5	4.7	10	9.3	37	34.6	55	51.4	

Source: Own elaboration.

The estimation of the log-binomial regression model revealed that students’ demographic characteristics and their perceptions of the benefits, contributions, and academic supplements of the simulated hospital significantly influenced the perceived comprehensiveness of simulation-based training.

The Nagelkerke R² coefficient indicated that the model explained 91.9% of the total variance in comprehensiveness perception. Model performance metrics showed excellent predictive power, with a sensitivity of 99.8%, a specificity of 87.8%, and an overall correct classification rate of 98.7% (Table 3).

The regression model identified several significant predictors of students’ perception of the comprehensiveness of simulation-based training. Specifically, each additional academic year completed was associated with a 0.3% increase in the likelihood of perceiving the training as comprehensive. Single students demonstrated a 13.3% higher probability of reporting comprehensive experiences compared to their non-single counterparts.

Students residing in rural areas were 1.2 times more likely to perceive the training as comprehensive than those living in urban areas. A positive evaluation of the simulation’s benefits was associated with a 1.1-fold increase in perceived comprehensiveness, while a positive appraisal of the simulation’s contributions corresponded to a 3.4-fold increase. Furthermore, students who positively rated the academic supplement dimension were 1.5 times more likely to report comprehensiveness. In contrast, male students were 71% less likely than female students to perceive simulation training as comprehensive.

Table 3. Estimation of parameters of the explanatory logistic regression model of the comprehensiveness of the simulated hospital for the clinical practices of a Faculty of Health in an H.E.I., in Cali Colombia 2022.

Predictive factors	Variables in the equation								
	B	Standar d error	Wald	Gl	Next.	R.P.	95% CI for R.P.		
							Lower	Superior	
Age	0.003	0.081	0.002	1	0.967	1,003	0.856	1,176	
Sex	-1.21	1.06	1,302	1	0.254	0.298	0.037	2,382	
Marital status	-2,021	1,301	2,413	1	0.12	0.133	0.01	1,697	
Semester	-0.553	0.745	0.551	1	0.458	0.575	0.134	2,476	
Area of residence	0.796	1,479	0.289	1	0.591	2,216	0.122	40.2	
Level of benefits	0.7419	0.863	22,725	1	0	2,101	1,265	3,401	

Level of contribution	1,5245	0.941	27,727	1	0	4,593	2,407	8,729					
Academic supplement level	0.9392	0.85	20,408	1	0	2,558	1,797	6,412					
Constant	-44,775	8,743	26,226	1	0	0							
Measures of goodness and fit of the model													
	Chi-square	GI	Next.										
Omnibus test - Model	494,235	8	0.0001										
R2 Nagelkerke	0.919												
Sensitivity	87.5%												
Specificity	99.8%												
Correct classification	98.7%												

Source: Own elaboration.

4. Discussion

The present study revealed a consistently high level of student satisfaction across the three evaluated modules of the simulated hospital experience: benefits (91.1%), contributions (90.4%), and academic supplement (90.8%).When considered jointly, 90.9% of students rated the overall experience as comprehensive, with higher agreement among those aged 17–19, female students, rural residents, those enrolled in advanced semesters, and single individuals. The gender distribution in the sample was predominantly female, with a ratio of five women to every man. This pattern is consistent whit previous research in health education. While studies involving medical students tend to report more gender-balanced samples [21], research in nursing education, such as Calderón Calderón et al. (2020) [22], mirrors the female predominance observed in our study. This reflects a historical continuity in the feminization of health professions, particularly nursing, dating back to Florence Nightingale [23].

Demographically, the majority of students were aged 20–24, single, and in upper-level semesters—an expected profile for health sciences students in Colombia, where clinical placements intensify from the fifth semester onward. These characteristics align with findings by Carvajal et al. (2023) [24] in the same region. The predominance of urban residence reflects the demographic distribution of Santiago de Cali, where approximately 90% of the population lives in urban areas [25]. The notable representation of Afro-Colombian students is also aligned with official demographic data from the 2018 national census [25].

Taken together, these findings emphasize the importance of considering contextual and sociodemographic variables—such as gender, age, and place of residence—in the planning, implementation, and evaluation of clinical simulation programs.

In terms of perceived benefits, over 90% of students positively rated the usefulness of simulated hospital experiences. This is consistent with Alconero-Camarero et al. [26], who reported a 93.8% approval rate among nursing students in Spain, and with Carvajal et al. (2023) [24], who found similar appreciation among physiotherapy students in Colombia. Simulated environments have repeatedly been recognized as essential for skill development in a controlled and safe setting [27].

The lowest-rated item in the benefits module related to the perceived differences between simulation and real-life procedures (85.2%). This finding highlights one of the enduring limitations of simulation: the challenge of replicating clinical realism. Riancho et al. (2012) [28] and others have emphasized the need for further pedagogical and technological refinement to narrow this gap.

Conversely, the highest-rated item (90.4%) acknowledged the relevance of simulated practice in preparing students for real clinical procedures. This reinforces prior findings suggesting that simulation is effective for transferring technical competencies into clinical performance [24,29].

Within the contributions module, the lowest score (85.5%) was observed in relation to decision-making in real clinical practice. Although still high, this result suggests that students perceive a limit to how well simulations replicate the complex, dynamic nature of clinical decision-making. Similar

concerns have been raised in the literature [30–32], which caution against viewing simulation as a complete replacement for real clinical exposure.

The academic supplement module received slightly lower ratings, particularly regarding time sufficiency (83.4%). This is in line with previous studies that cite insufficient time as a barrier to skill development [24,35]. On the other hand, the availability of clear explanations regarding the rules and operations of the simulated hospital was highly appreciated (91.1%), supporting the idea that well-organized environments enhance student engagement and learning [36].

The overall perception of comprehensiveness (90.9%) confirms the value of simulation in health education. This was especially pronounced among younger students (17–19 years), those in advanced semesters, women, and rural residents. The higher satisfaction among rural students may reflect how simulation mitigates barriers related to geographic and systemic inequities in clinical access [25].

Among the three simulation modules, the “contributions” domain was the strongest predictor of perceived comprehensiveness. This module—centered on theoretical reinforcement, skill acquisition, and preparation for decision-making—was also highly rated in international studies highlighting simulation’s role in developing critical competencies [21,22,24].

4.1. Study Limitations

This study presents several limitations that should be acknowledged. First, the developed scale was not compared with an established gold standard. Nonetheless, its design was grounded in a solid theoretical framework and included items adapted from previously validated instruments. The construct underwent a structured validation process, including expert review and pilot testing, which supports its content and face validity. Second, the analysis did not disaggregate results by academic program. As a result, potential differences in perceptions of the simulated hospital experience among students from different health science disciplines were not explored. Future studies may benefit from incorporating subgroup analyses to better understand discipline-specific needs, expectations, and outcomes related to clinical simulation.

5. Conclusions

This study confirms the relevance of simulated hospitals as effective pedagogical tools in the training of future health professionals. Students reported high satisfaction across all dimensions, with 90.9% perceiving the simulated hospital experience as comprehensive. The contribution module was the strongest predictor of this perception, especially among younger students, women, those in advanced semesters, and rural residents. This study’s main strength is its broad scope, including students from eight health programs, offering a more diverse view of simulation-based learning. It also features a rigorously developed and validated measurement construct. The innovative use of log-binomial regression allowed for the identification of key predictors of perceived comprehensiveness. Despite these strengths, the results highlight the need for continuous improvements in the realism of simulation environments to better reflect clinical complexity and support effective learning.

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