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Clinical simulation: Validation of a quality and satisfaction survey in a group of medical students

Simulación clínica: Validación de encuesta de calidad y satisfacción en un grupo de estudiantes de Medicina

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Summary:

Multiple studies have demonstrated the effectiveness of simulation in teaching, but it is important to know the degree of student satisfaction with this strategy and to have a standardized instrument for this. The objectives of this work were to validate the Durá Ros Clinical Simulation Quality and Satisfaction Survey and analyze the relationship between the level of satisfaction, the number of subjects with simulation practices taken and the academic average. An observational, descriptive and cross-sectional study included students from the Medicine program at the University of Social and Business Sciences who took subjects with clinical simulation (n=122). The survey was presented as a self-administered form with response options on a Likert scale. The Mann-Whitney "U" tests were used to contrast hypotheses when comparing the global levels of agreement according to age groups and dichotomized average, and the Kruskal-Walis tests were used for the level of agreement according to the current year of the degree. In order to summarize the survey items into dimensions, a principal component analysis (PCA) was performed. The median level of agreement was 5, except for realism of the scenarios and duration of the activities. No significant differences were found in the degrees of agreement considering the number of subjects taken and the academic average. The absence of association between satisfaction, the number of subjects taken and the academic average demonstrates that the strategy *per se* is a motivator of learning. The exploratory factor analysis suggests that the survey is valid and that the number of items could be reduced without affecting the dimensions considered.

Keywords: Clinical simulation; undergraduate medical education; validation study, satisfaction survey

Resumen:

Múltiples estudios han demostrado la eficacia de la simulación en la enseñanza pero resulta importante conocer el grado de satisfacción de los estudiantes con respecto a esta estrategia y contar con un instrumento estandarizado para ello. Los objetivos de este trabajo fueron validar la Encuesta de Calidad y Satisfacción de Simulación Clínica de Durá Ros y analizar la relación entre el nivel de satisfacción, el número de asignaturas con prácticas de simulación cursadas y el promedio académico. En un estudio observacional, descriptivo y transversal se incluyeron estudiantes de la carrera de Medicina de la Universidad de Ciencias Sociales y Empresariales que cursaron asignaturas con simulación clínica (n=122). La encuesta fue presentada como un formulario autoadministrado con opciones de respuesta en escala de Likert. Se emplearon las pruebas "U" de Mann-Whitney para el contraste de hipótesis al compararse los niveles de acuerdo globales según grupos de edad y promedio dicotomizado y de Kruskal-Walis para el nivel de acuerdo según el año en curso de la carrera. Con el objetivo de resumir los ítems de la encuesta en dimensiones, se realizó un análisis de componentes principales (ACP). La mediana en el nivel de acuerdo fue 5, excepto en realismo de los escenarios y duración de las actividades. No se encontraron diferencias significativas en los grados de acuerdo considerando el número de asignaturas cursadas y el promedio académico. La ausencia de asociación entre la satisfacción, el número de asignaturas cursadas y el promedio académico demuestra que la estrategia *per se* es motivadora del aprendizaje. El análisis de factores exploratorio sugiere que la encuesta es válida y que la cantidad de ítems de la misma podría ser reducida sin afectar las dimensiones consideradas.

Palabras clave: Simulación clínica; educación médica de pregrado; estudio de validación, encuesta de satisfacción

1. Introduction

The complex learning required by clinical teaching involves the integration of knowledge, skills and attitudes with the intention that the student achieves their application in daily professional practice. Clinical simulation, as a teaching strategy in health sciences education, allows the development of real-life scenarios in a space controlled by teachers. This provides the student with the security of being able to later face real-life experiences with greater practical knowledge of situations, and with much more effective management of personal relationships. The clinical simulation provides the "novice" student with scaffolding (support and containment) and a complement to hospital practice. In addition, it allows students to be evaluated at the highest level ("does") of Miller's pyramid, favoring the training of more competent graduates (1). Simulation creates an ideal environment for education, because activities can be designed to be predictable, consistent, standardized, safe, and reproducible (2).

Multiple studies have demonstrated the effectiveness of simulation in teaching basic sciences, clinical knowledge, procedural skills, teamwork and communication, as well as in assessment at the undergraduate and graduate medical education level (2). According to Davini, teaching with simulations reaches a wide variety of possibilities with different specific alternatives. In stage simulations, interaction skills with others, communication, decision-making and negotiation are promoted; including the management of information and the understanding of explicit and implicit rules in specific situations. In simulations with instruments or simulators, skills in learning work methods, procedures, use of instruments, decision making and action plan are emphasized. Finally, virtual simulations develop information and technology management skills, the use of symbols, graphics and data, the understanding of problems; including searching, organizing and integrating subject or disciplinary knowledge into practical situations (3). Clinical simulation

promotes meaningful learning. There are two key ideas in his teaching: fidelity and trainers (4). The first considers how much the appearance and behavior of the simulation/simulator corresponds or agrees with the appearance and behavior of the real world. Trainers are teachers who require training and skills to integrate simulation into classrooms. The benefits for students involved in simulation experiences are learning in a risk-free environment, being able to experience interactive learning, having the opportunity to practice skills, and receiving immediate feedback from the teacher in the debriefing section. In this section, students self-evaluate and reflect on their performance (knowledge, skills and attitudes) with the aim of improving or maintaining their performance in the future.

Different publications from Spain, Mexico and Colombia have measured the degree of satisfaction in medical students with different scales, discovering a high degree of satisfaction in learning, for example, obstetrics and in the preparation of medical records (5-6). At the University of Monterrey, similar findings were also reported among students who performed clinical simulation (4). In Argentina, an investigation was carried out on the perception of 5th year Medicine students at the National University of the Northeast (UNNE), in relation to clinical simulation through a self-developed survey that showed a high level of satisfaction. (7). In the present work, with the intention of knowing the level of satisfaction of the students of the Medicine degree at the University of Business and Social Sciences (UCES) regarding the clinical simulation, the Spanish version of the "Quality Survey" was used. and satisfaction with clinical simulation", survey adapted and validated by Durá Ros for nursing students (8). It takes as reference a survey created at Harvard University in 1998 (9), developed using an expert panel technique, to describe student satisfaction with high-fidelity clinical simulation. This is a type of simulation designed for the acquisition of advanced skills and the resolution of clinical cases. The questionnaire consists of 15 items with a unifactorial design related to learning through high-fidelity clinical simulation as a teaching tool and an observations section with open responses. The validation of this instrument does not present psychometric properties applied to medical students in Argentina.

The techniques used to validate the survey were principal component analysis (PCA) and factor analysis (FA), which attempt to simplify the interpretation of the responses by grouping the variables that present high correlation and, therefore, express certain dimensions (latent variables). If these dimensions can be recognized, the number of variables can be reduced and the analysis simplified by eliminating redundant information. The "extraction" criterion of the components can be a pre-established quantity or, most frequently, the criterion of their contribution to the total variance, which is known as "eigenvalue", which allows discarding those with eigenvalues less than 1 per his little contribution. A previous step to establish whether the reduction is pertinent is the calculation of the Kaiser-Meyer-Olkin (KMO) coefficient and Bartlett's test of sphericity, which evaluate partial correlations between the variables. The high values of the KMO and the statistical significance of the sphericity test ensure the validity of the sample to perform the FA.

The main objective of this research was to validate the Durá Ros survey (Clinical Simulation Quality and Satisfaction Survey) for use in students of all years of the UCES Medicine degree; In addition, the relationship between the level of satisfaction and the number of simulation subjects taken and the overall average of the degree was analyzed.

2. Methods

A quantitative, observational, descriptive and cross-sectional study was carried out. Students of the Medicine program at the University of Social and Business Sciences,

enrolled in 2023, who were studying any of the subjects in which clinical simulation is applied as a teaching strategy, were included. These were: Primary Health Care (1st year-28 sessions), Initiation to Clinical Practice (2nd year-28 sessions), Family Medicine (3rd year- 6 sessions), Semiology and Medical Propedeutics (4th year-12 sessions) , Internal Medicine (5th year - 9 sessions), Integration of Clinical Training I and II (4th and 5th year, respectively - 4 and 9 sessions) and Annual Rotating Internship Simulation Workshop (6th year - 20 sessions). The activities were carried out in a simulation center, with groups of 8 to 10 students. The teacher in charge, in a first period lasting 10 minutes, explored the previous knowledge related to the topic to be discussed in the simulation. The simulation itself was then carried out in a 40 to 60 minute session. At the end of the class, 30 minutes were dedicated to discussing the case (debriefing).

The instrument used to assess satisfaction in the use of clinical simulation was the Spanish version of the scale "Quality and Satisfaction Survey of Clinical Simulation" by Durá Ros (9), which consists of 15 items with numerical responses for the different degrees of agreement. ranging from 1 (strongly disagree) to 5 (strongly agree) and one item for observations. In the present study, item No. 9 "in simulation it is useful to see one's own recorded performances" was deleted since no routine film recordings were made. Thus, the maximum test score was reduced from 75 to 70 points.

This survey was applied during the month of July 2023, after 10 weeks of taking the different subjects. The information was collected through a "Google Forms" form. The link was sent by email. The voluntary and anonymous nature of participation was established in writing and the protection of personal data was guaranteed through the assignment of an identification number to the forms. Submissions that responded to all the items raised were considered valid. The study was authorized by the academic authorities of the Faculty of Health Sciences who agreed to consider it as "risk-free" due to its observational and voluntary nature.

Statistic analysis.

The variables "age", "sex", "year of the course in progress" and "grade average" were analyzed; the latter was dichotomized by the median. Nominal and ordinal variables were summarized in proportions and continuous variables in median and interquartile range (IQR). The Mann-Whitney "U" tests were used to contrast hypotheses when comparing the global levels of agreement according to age groups and dichotomized average, and the Kruskal-Wallis test was used for the level of agreement according to the current year of the degree. Spearman's correlation coefficient was calculated between the total score and the grade averages. In order to summarize the survey items in dimensions, a Principal Component Analysis (PCA) was carried out after calculating the Kaiser-Meyer-Olkin (KMO) coefficient (the PCA was considered relevant if it was greater than 0.50). and Bartlett's test of sphericity. Varimax rotation with Kaiser normalization was applied to the component matrix obtained taking into account eigenvalues greater than 1. In this research, the survey items were grouped for the analysis of their validity into three factors: Factor 1 groups items 1, 3,4 and 10 of the same. The first three are associated with the assessment of simulation as a pedagogical method and its ability to improve technical skills and critical reasoning, while item 10 assesses the competence of the instructors. In factor 2 you can bring together items 5 and 7 in the concept "association of theory and practice" and item 6, which refers to the feeling of "security and confidence" acquired with the simulation. Factor 3 weights items 9 (adequate duration of sessions) and 14 (general satisfaction). The reliability of the scale and the extracted and rotated components was evaluated with Cronbach's alpha coefficient (α). In all cases a statistical significance level of <0.05 was set. The SPSS program (IBM, inc) version 26 was used.

3. Results

122 responses were obtained. The median age was 24 years (IQR=21.5-28); 84 (68.9%) were women; 28.7% are first-year students, 14.8% are second-year students, 17.2% are third-year students, 12.3% are fourth-year students, 15.6% are fifth-year students, and 11.5% are sixth-year students. The median academic average at the time of the survey was 7 (IQR=6-8). In all dimensions, a median level of agreement equal to 5 was obtained except in those referring to the realism of the scenarios and the duration of the activities (in both cases median of 4, table 1).

Table 1 . Scores of the items of the "Clinical Simulation Quality and Satisfaction Survey".

	Mean (SD)
1. Simulation is a useful teaching method for learning	4.85 (0.477)
2. The scenarios where the simulation takes place are realistic	4.20 (0.988)
3. Experience with simulation has improved my technical skills	4.68 (0.580)
4. Simulation helps develop critical reasoning and decision-making decisions	4.61 (0.768)
5. The simulated cases adapt to my theoretical knowledge	4.60 (0.526)
6. The experience with the simulator has increased my security and confidence	4.59 (0.543)
7. Simulation has helped me integrate theory and practice	4.66 (0.556)
8. The workshops with the simulator have motivated me to learn	4.50 (0.672)
9. The duration of the case is appropriate	4.21 (0.968)
10. Teacher training is adequate	4.68 (0.698)
11. Simulation encourages communication between team members	4.50 (0.754)
12. Clinical simulation helps prioritize future professional actions	4.58 (.0704)
13. Interaction with simulation has improved my clinical competence	4.50 (0.743)
14. In general, the experience with clinical simulation has been satisfactory.	4.56 (0.682)
SD: Standard deviation	

When evaluating the relevance of the sample, a KMO coefficient of 0.893 was obtained; Bartlett's test of sphericity was statistically significant ($\chi 2=1094.973$; $p < 0.000$), which enabled the factor analysis. Table 2 presents the analysis of the main components of the survey. Two of these were extracted for presenting eigenvalues greater than 1 and it was decided to forcefully include the third component, which presented an eigenvalue of 0.961 (fig. 1). The three explain 70.33% of the total variance. (Table 3). The scale was highly reliable (Cronbach's alpha coefficient = 0.924).

No statistically significant differences were observed (Table 4) in the degrees of agreement considering the sex of the students (p=0.068) or the year of the degree (p=0.524), nor their academic average dichotomized by the median (p=0.463).), nor the number of subjects taken with simulation (p =0.930).

Table 2 : Matrix of rotated components

	Components		
	1	2	3
1. Simulation is a useful teaching method for learning	,799	-,148	.243
2. The scenarios where the simulation takes place are realistic	.506	,490	,200
3. Experience with simulation has improved my technical skills	.807	.261	.142
4. Simulation helps develop critical thinking and decision making. of decisions	.738	,314	.280
5. The simulated cases adapt to my theoretical knowledge	.123	.786	.259
6. The experience with the simulator has increased my confidence and trust	,230	.810	.028
7. Simulation has helped me integrate theory and practice	,189	.711	.295
8. The workshops with the simulator have motivated me to learn	,596	,207	.542
9. The duration of the case is appropriate	.258	.236	.744
10. Teacher training is adequate	.729	.388	,208
11. Simulation encourages communication between team members	.483	,299	,599
12. Clinical simulation helps prioritize future actions professional	.653	.396	.432
13. Interaction with simulation has improved my clinical competence	.013	.552	.670
14. In general, the experience with clinical simulation has been satisfactory.	.457	.044	.762

Table 3: Extraction method: principal component analysis.

	Sums of charges squared of the extraction			Sums of charges squared of rotation		
Component	Total	% variance	% accumulated	Total	% variance	% accumulated
1	7,324	52,317	52,317	4,017	28,696	28,696
2	1,561	11,151	63,468	3,010	21,504	50,200
3	.961	6,863	70,331	2,818	20,131	70,331

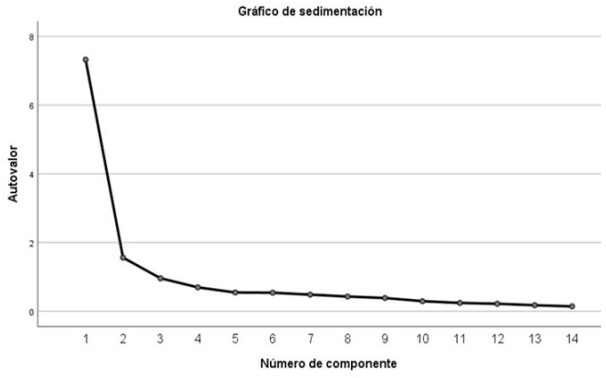

Figure 1: Sedimentation graph.

Table 4. Relationship between degree of satisfaction and sex, year of study, average and subjects taken.

	Median (IQR)		Hypothesis testing	P value
Sex				
Women	67.50 (60-70)		Mann-Whitney	0.068
Men	65 (57-68.50)		"U"=1232,500	
Average				
<7	67 (58.50-70)		Mann-Whitney "U" =	0.463
≥ 7	65 (58.75-69.25)		880,500	
Year of the race				
1st	66 (55.20-70)		Kruskal-Wallis=4.177	0.524
2nd	66 (56-70)			
3rd	67 (60-69)			
4th	69.50 (59-70)			
5th	66 (57-69.50)			
6th	61 (54.50-68.50)			
Number of subjects with simulation				
<4	66 (60-69)		Mann-Whitney "U" =	0.930
≥ 4	62.50 (59-70)		915,000	

IQR: interquartile range.

4. Discussion

The experience with the use of clinical simulation has been satisfactory, as has been reported in other research in undergraduate medical and nursing students (4, 8, 9,10). It is important to know the degree of student satisfaction in the use of clinical simulation and to have a validated instrument for this purpose. As mentioned, fidelity and trainers are essential in teaching with clinical simulation (4). Both aspects can be evaluated by measuring the degree of satisfaction through the scale proposed in this work. Knowing these points is essential to identify areas for improvement in simulation activities.

Regarding the scenarios where the simulation was developed, 42.7% of the students agreed and 44.4% strongly agreed that they were realistic scenarios. These percentages could be explained because, as Okuda et al. proposes, "the complete environment simulation" that includes high-fidelity mannequins, other health professionals, auxiliary equipment and elements that replicate the clinical environment, is what students They tend to perceive them as more realistic, compared to less complex scenarios such as those used in some simulation instances in this study (2). On the contrary, another study interprets this finding as a perception of the students that "although the scenarios are highly realistic, the majority are not in favor of replacing real patients with clinical examinations with simulators" (4).

Regarding the duration of the simulation session, only 47.6% considered it very appropriate, as in the study carried out by Perdomo et al. (10). Durá Ros proposes that, although there is no established duration, the scenario should take place in 15-20 minutes (9). Other investigations found results similar to ours, without questioning the reason, or interpreting that the duration of the case should be adjusted to the real times taking into account the particular needs of each student (4,10). In the present work, this result could be due to the variability in the number of students per simulation session, which in some cases could reduce the individual exposure time.

The students also strongly agreed at 75% that the teachers had adequate training to carry out this task. Seven out of 10 students strongly agreed that the simulation helped improve their technical skills, critical thinking, and decision making. This coincides with findings in other studies, both undergraduate and postgraduate (4, 11,12).

The survey also evaluates the student's metacognition process, asking if the simulation has helped them develop critical reasoning and decision making; or has improved your technical skills, or has helped to integrate theory and practice. This encourages students to have a critical attitude towards information, knowledge and their own learning strategies. Students also agreed that the simulation promotes communication skills in general and with team members. According to Alconero et al. (13) This tool also improves communication with your peers.

It is interesting to note that, as mentioned in the results, no statistically significant differences were observed in the level of satisfaction considering the sex of the students, nor the year of the degree, history of subjects taken in simulation, nor their dichotomized grade average. by the median. At the date of writing this work, these associations have not been explored in other research.

Regarding the exploratory factor analysis of the instrument, it should be noted that different studies have shown different results. It is not possible to attribute a univocal meaning to the variables that make up each factor. The exploratory factor analysis suggests that the number of survey items could be reduced without affecting the dimensions considered (tables 2 and 3). Durá Ros (9) in his doctoral thesis analyzed the results of the satisfaction survey (18 items) in two blocks based on the item statements, without rehearsing the factor analysis: "simulation as a methodology and perception of the quality of teaching" and "scenarios, resources and non-technical elements". In recent studies (14,15) the questions were divided into two dimensions: the first linked to the "usefulness of the methodology related to the individual and the development of skills", that is, the significant learning perceived by the individual according to with the level of confidence, satisfaction and security when performing a task complemented by the acquisition of competence and clinical reasoning acquired during the simulations; and the second dimension refers to "simulation design, duration, visualization of the case, communication and teamwork."

Simulation is a valuable method for teaching skills and abilities and is favored by students in all published experiences. There is almost absolute agreement regarding the integration of theory with practice and the improvement of technical and clinical skills. The criticism of the duration of the sessions, which seems to be insufficient, is also coincidental. This puts the focus on the way in which the activity is implemented, on the training of the instructors and on the depth of the debriefing, so, without doubting the benefits of the method, the evaluation could, in the future, be limited to these aspects.

5. Conclusions

- The clinical simulation presents a high degree of satisfaction among students of all years of the Medicine degree. The Dura Ros survey is a valid instrument to measure satisfaction. The exploratory factor analysis suggests that the number of survey items could be reduced without affecting the dimensions considered.
- The fact that the high degree of satisfaction is independent of the number of simulation subjects taken as well as the student's academic average demonstrates that the strategy *per se* is a motivator for learning.

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