Original Article

TEXTO & CONTEXTO ENFERMAGEM
TEXT & CONTEXT NURSING TEXTO & CONTEXTO ENFERMERÍA

IMPACT OF HIGH-FIDELITY SIMULATION IN PEDIATRIC NURSING TEACHING: AN EXPERIMENTAL STUDY

Camila Farinati Nadler[1]
Juliana Coelho Pina[2]
Suyanne de Quadros Schmidt[2]
Aline Cristiane Cavicchioli Okido[3]
Luciana Mara Monti Fonseca[4,5]
Patrícia Kuerten Rocha[2]
Jane Cristina Anders[6]
Keyla Cristiane do Nascimento[7]
Saionara Nunes de Oliveira[8]

[1]Hospital Infantil Joana de Gusmão. Florianópolis, Santa Catarina, Brasil.
[2]Universidade Federal de Santa Catarina, Programa de Pós-Graduação em Enfermagem. Florianópolis, Santa Catarina, Brasil.
[3]Universidade Federal de São Carlos, Programa de Pós-Graduação em Enfermagem. São Carlos, São Paulo, Brasil.
[4]Universidade de São Paulo, Programa de Pós-Graduação Enfermagem em Saúde Pública. Ribeirão Preto, São Paulo, Brasil.
[5]Universidade de São Paulo, Programa de Pós-Graduação em Mestrado Profissional de Tecnologia e Inovação em Enfermagem. Ribeirão Preto, São Paulo, Brasil.
[6]Universidade Federal de Santa Catarina, Programa de Pós-Graduação Gestão do Cuidado em Enfermagem – Modalidade Profissional. Florianópolis, Santa Catarina, Brasil.
[7]Universidade Federal de Santa Catarina, Departamento de Enfermagem. Florianópolis, Santa Catarina, Brasil.
[8]Universidade Federal de Santa Catarina, Hospital Universitário Professor Polydoro Ernani de São Thiago. Florianópolis, Santa Catarina, Brasil.

ABSTRACT

Objective: to assess the impact of high-fidelity clinical simulation on undergraduate teaching, specifically in the Pediatric Nursing area.
Method: a quasi-experimental study of the pre- and post-test type, developed at three public Higher Educations Institutions (HEIs) in Brazil. The participants were 93 undergraduate Nursing students, enrolled in the Pediatric Nursing academic disciplines, and randomly allocated to the control or experimental groups. The data were collected in the first half of 2017, through a structured knowledge test and the Satisfaction with Simulated Clinical Experiences Scale. The experimental group received the usual intervention (participation in the theoretical and theoretical-practical activities offered in the disciplines) and the study intervention (high-fidelity clinical simulation); the control group only received the usual intervention. The data were analyzed by means of descriptive and analytical statistics. An explanatory model was prepared by means of multiple linear regression to assess the impact of simulation on teaching.
Results: the mean difference between the knowledge pre- and post-tests was 4.04 points (p=0.0004) higher among the experimental group participants, indicating a greater increase in knowledge with the simulation. The participants from University A, who performed the simulation after the theoretical activities and before the theoretical-practical activities, obtained a higher mean difference between the knowledge pre- and post-tests (by 3.89 points, p=0.0075) than that of obtained by the participants from the other institutions. In relation to the satisfaction scale, high scores were achieved (mean=9.11±0.67).
Conclusion: high-fidelity clinical simulation in Pediatrics contributed to increasing the Nursing students' knowledge and satisfaction levels.

DESCRIPTORS: Education nursing. Learning. Pediatric nursing. Educational technology. Simulation. Personal satisfaction.

HOW CITED: Nadler CF, Pina JC, Schmidt SQ, Okido ACC, Fonseca LMM, Rocha PK, Anders JC, Nascimento KC, Oliveira SN. Impact of high-fidelity simulation in pediatric nursing teaching: an experimental study. Texto Contexto Enferm [Internet]. 2022 [cited YEAR MONTH DAY]; 31:e20210410. Available from: https://doi.org/10.1590/1980-265X-TCE-2021-0410en

O IMPACTO DA SIMULAÇÃO CLÍNICA DE ALTA FIDELIDADE NO ENSINO DE ENFERMAGEM PEDIÁTRICA: ESTUDO EXPERIMENTAL

RESUMO

Objetivo: avaliar o impacto da simulação clínica de alta fidelidade no ensino de graduação, na área de enfermagem pediátrica.
Método: estudo quase experimental, do tipo pré e pós-teste, desenvolvido em três instituições de ensino superior públicas, no Brasil. Participaram 93 graduandos em enfermagem, matriculados nas disciplinas de Enfermagem Pediátrica, alocados aleatoriamente no grupo controle ou experimental. Os dados foram coletados no primeiro semestre de 2017, por meio de teste de conhecimento estruturado e da Escala de Satisfação com as Experiências Clínicas Simuladas. O grupo experimental recebeu a intervenção habitual (participação nas atividades teóricas e teórico-práticas oferecidas nas disciplinas) e a intervenção do estudo (simulação clínica de alta fidelidade); o grupo controle recebeu apenas a intervenção habitual. Os dados foram analisados mediante estatística descritiva e analítica. Para avaliar o impacto da simulação no ensino, foi elaborado um modelo explicativo, por meio da regressão linear múltipla.
Resultados: a diferença média entre o pré e pós-teste de conhecimento foi 4,04 pontos (p=0,0004) maior entre os participantes do grupo experimental, indicando maior incremento no conhecimento com a simulação. Os participantes da instituição A – que realizaram a simulação após as atividades teóricas e antes das atividades teórico-práticas – obtiveram uma diferença média entre o pré e pós-teste de conhecimento superior (em 3,89 pontos, p=0,0075) àquela obtida pelos participantes das demais instituições. Em relação à escala de satisfação, as pontuações atingiram um alto nível (média=9,11±0,67).
Conclusão: a simulação clínica de alta fidelidade em pediatria contribuiu para o incremento do conhecimento e satisfação de acadêmicos de enfermagem.

DESCRITORES: Educação em enfermagem. Aprendizagem. Enfermagem pediátrica. Tecnologia educacional. Simulação. Satisfação pessoal.

EFECTO DE LA SIMULACIÓN CLÍNICA DE ALTA FIDELIDAD EN LA ENSEÑANZA DE ENFERMERÍA PEDIÁTRICA: ESTUDIO EXPERIMENTAL

RESUMEN

Objetivo: evaluar el efecto de la simulación clínica de alta fidelidad en la carrera de grado del área de Enfermería Pediátrica.
Método: estudio cuasi experimental del tipo pre y post test, desarrollado en tres instituciones públicas de enseñanza superior de Brasil. Participaron 93 estudiantes de la carrera de grado de Enfermería, inscriptos en las disciplinas académicas Enfermería Pediátrica y asignados aleatoriamente al grupo control o experimental. Los datos se recolectaron durante el primer semestre de 2017 por medio de una prueba de conocimiento estructurada y de la Escala de Satisfacción con las Experiencias Clínicas Simuladas. Al grupo experimental se le aplicó la intervención habitual (participación en las actividades teóricas y teórico-prácticas ofrecidas en las disciplinas) y la intervención del estudio (simulación clínica de alta fidelidad); el grupo control solamente recibió la intervención habitual. Los datos se analizaron por medio de estadística descriptiva y analítica. Para evaluar el efecto de la simulación en la enseñanza se elaboró un modelo explicativo por medio de regresión lineal múltiple.
Resultados: la diferencia media entre el pre y el post test de conocimiento fue 4,04 puntos (p=0,0004) más alta entre los participantes del grupo experimental, lo que indica un mayor aumento en el conocimiento con la simulación. Los participantes de la Institución A – que realizaron la simulación después de las actividades teóricas y antes de las teórico-prácticas – obtuvieron una diferencia media más elevada entre el pre y el post-test de conocimiento (3,89 pontos más, p=0,0075) que la alcanzada por los participantes de las otras instituciones. En relación con la escala de satisfacción, las puntuaciones alcanzaron un nivel elevado (media=9,11±0,67).
Conclusión: la simulación clínica de alta fidelidad en Pediatría contribuyó a mejorar los niveles de conocimiento y satisfacción de los estudiantes de Enfermería.

DESCRIPTORES: Educación en enfermería. Aprendizaje. Enfermería pediátrica. Tecnología educativa. Simulación. Satisfacción personal.

INTRODUCTION

Pediatric Nursing teaching implies challenges for the training of future professionals. *Per se*, the specific characteristics of children's growth and development process already require differentiated skills to ensure non-traumatic and humanized care. In addition to that, fear of performing the procedures, as well as difficulty communicating and interacting with the children and their family, requires Nursing students to develop skills that support safety of this population, even during the undergraduate course[1–2].

The use of educational technologies has been pointed out as a facilitating resource for Pediatric Nursing teaching and practice[3]. In this context, clinical simulation has gained significant spaces in the pediatric scope, due to the potential benefits to patient safety and ethics in care, as the students will be better prepared for real situations[2,4].

Regarding the Pediatric Nursing teaching during undergraduate courses, clinical simulation has been used to prepare students for the care of children with common clinical conditions[5–6] and chronic/palliative diseases[7–8] for the management of complications[9–10]; to promote family-centered care[11–12], and in the Primary Health Care context[13–15].

Simulation has been pointed out in the scientific literature as an active teaching methodology, to the extent that the participants are actively involved in the teaching-learning process and assume their leading role[16]. Active methodologies recommend substituting memorization and simple information transfer through construction of knowledge from the experience of real or simulated situations of the professional practice, stimulating the capabilities of critical and reflective analysis[16].

Simulation can contribute to skills development in different ways, according to the fidelity level. The procedural skills are promoted by using low-fidelity (static) simulators. With medium-fidelity simulators it is possible to advance in realism (such as auscultation of heart and respiratory sounds), with the possibility of integrating procedural activities with a diagnostic process, for example[17]. In high-fidelity clinical simulation, a realistic simulator is associated with a well-designed scenario, with well-established pedagogical objectives, sound and image technology and a duly prepared work team. In this sense, there is a transition from a practical scenario to a simulated clinical experience and the students can mobilize different skills (procedural, clinical, relational) to obtain certain competence(s), in a controlled and risk-free environment[2,17].

As a teaching strategy, high-fidelity clinical simulation exerts a potential effect on cognitive and behavioral education. An experimental study, which evaluated the impact of this simulation modality on the clinical performance of 30 Nursing students, identified that the mean score obtained by the experimental group (which received the usual intervention and the simulation) was significantly higher (by 13.89 points, $p<0.01$) than that obtained by the control group (which only received the usual intervention - practical clinical training)[18].

With the use of high-fidelity clinical simulation, the students show high levels of self-esteem and self-confidence in development of the procedures, increased internalization of the information and greater satisfaction with the learning process[5,13]. The results of a quasi-experimental research study evidenced the impact of high-fidelity clinical simulation on the development of critical thinking, self-confidence and satisfaction of Nursing students and nurses[19]. Considering the results obtained by the students, the difference between the means obtained in the pre- and post-tests was highly significant (10.93±1.49 *versus* 18.13±1.46; $p<0.0001$); in addition, the students manifested high satisfaction (mean of 4.86±0.28, out of a maximum score of 5.0 points) and self-confidence (mean of 4.93±0.25, out of a maximum score of 5.0 points) levels in the simulated clinical experience[19].

Students with greater self-confidence have more probabilities to succeed in their interventions because they are able to test and use their skills more easily, that is, they are able to take on new challenges and overcome failure more quickly[2,5,13]. In addition to the performance in the activities

proposed, the students' satisfaction with the simulated experiences is an important point to be evaluated and considered, as it is associated with greater involvement and motivation in the teaching-learning process[5,17].

Given the above, the importance of educational advancement in the technological field is justified, with the aspiration to new pedagogical approaches in Pediatric Nursing. Clinical simulation has been presented as a promising active methodology for the teaching-learning process, requiring diverse scientific evidence in the literature to justify the investment in realistic simulation practices, which are expensive.

In the international context there are a number of studies that assess the impact of simulation on Pediatric Nursing. Through mixed-methods research, two educational interventions (simulation and video) were compared for teaching Nursing students about the care of pediatric patients with end-stage renal disease[7]. The quantitative analysis did not evidence statistically significant differences between both groups in relation to knowledge acquisition; in turn, the qualitative analysis showed that both groups valued the teaching method used[7]. A quasi-experimental study was conducted among Nursing students to assess the impact of simulation on the teaching of the care to be provided to children with croup[5]. The results point to a significantly higher mean difference between the pre- and post-tests among students who received the theoretical educational intervention followed by simulation (E Group), when compared to those who only received the theoretical educational intervention (C Group), with regard to knowledge acquisition (E=0.22±1.74 *versus* C=0.17±1.10; p<0.001), to self-confidence in performance (E=0.73±0.58 *versus* C=0.50±0.42; p=0.011), and to satisfaction with the learning method (E=3.39±0.42 *versus* C=3.03±0.36; p<0.001)[5]. An experimental study conducted with Nursing students, which compared the effect of training with clinical simulation and with a low-fidelity simulator in teaching epileptic seizure management in children, did not find statistically significant differences between both methods, regarding knowledge and self-confidence gains in the students; however, it identified a significant increase in the attitude of the students that participated in the clinical simulation (pre-test=61.05±6.44; post-test=63.11±5.82; p=0.008), which was not identified in the group that used the low-fidelity simulator[9].

Despite the results presented, it is noted that few studies perform multiple data analyses. At the national level, a recent study points to the need for research studies with methodological designs capable of testing the effectiveness of simulation in Pediatric Nursing teaching[20]. In view of this scenario, the study objective is to assess the impact of high-fidelity clinical simulation on undergraduate Pediatric Nursing education, considering cognitive learning and students' satisfaction.

METHOD

This is a quasi-experimental study of the pre- and post-test type[21]. It was developed in two universities from the state of São Paulo (identified as A and B) and in another from Santa Catarina (identified as C).

The students included in this study were those attending the undergraduate Nursing course regularly enrolled in academic disciplines relevant to the Pediatric Nursing contents, specifically hospitalized children, at the three educational institutions. The participants were recruited by the researcher responsible for each center (professors of the academic disciplines and authors of this study), taking care that the invitation to the students was not made by them but by scholarship students, from other phases of the course or graduate studies. All the students who met the criteria established were included, within a period of one semester, which is the duration of the disciplines at the three institutions. In other words, work was conducted with the entire population of interest. Data collection took place in the first half of 2017.

As for the exclusion criteria, students who had previously attended the academic disciplines in question, corresponding disciplines or those who were absent in any of the simulated practices were excluded, as it is considered that both previous experience in the discipline and the current unfinished experience in the simulations can generate biases in the results. Subjects that have not finished any of the knowledge test phases were also excluded.

In each educational institution, the participants were divided into experimental (EG) and control (CG) groups in a 1:1 ratio, by means of a draw (randomization) generated in the OpenEpi Random program.

The impact of the simulation on teaching was defined through the change in the participants' level of knowledge, in relation to the contents covered in the scenarios in question. To this end, a structured knowledge test was applied to all study participants (EG and CG), produced by the researchers from all three educational institutions (authors of this study), although not validated. The test was applied at two moments, for the two groups (EG and CG) and in the three institutions: at the beginning of the disciplines (in March 2017, after accepting to participate in the study, and before the first theoretical class) and at the end of the disciplines (June 2017). Therefore, even though the simulations were performed in different periods/stages at the three institutions, application of the pre- and post-tests took place at the same time.

Prior to data collection, the knowledge test was applied to 05 undergraduate Nursing students (who did not comprise the study population) for adjustment purposes. The test contained an initial section to characterize the individuals (gender, age, schooling and previous experience in the health area) and 20 multiple-choice questions about Nursing care in clinical situations of interest: respiratory distress, respiratory failure, diarrhea, dehydration, vomit aspiration, and fever. The test score was obtained by adding up the points of each question.

After the simulated practices, the Satisfaction with Simulated Clinical Experiences Scale, developed and validated by Baptista et al.[17], was also employed. It is noted that authorization for its use in this study was previously obtained from the authors. The Scale has 17 items, where each one can be assigned a score from 01 (expressing the lowest satisfaction level) to 10 (expressing the highest satisfaction level). The final score of the Scale refers to the mean of the values assigned to the items by the student[17].

The intervention was applied to the EG and, in addition to that, the students participated in the usual activities offered in the academic disciplines. The intervention consisted of the students' participation in high-fidelity clinical simulations, which were operationalized through the application of identical scenarios at the three institutions, which contemplated children's health care under clinical conditions and complications, in hospital contexts.

The following clinical scenarios were used: 1) respiratory distress and failure; 2) diarrhea and dehydration; 3) vomit aspiration; and 4) fever. It is noteworthy that these were prepared by researchers from the three participating institutions, according to the standards recommended by the International Nursing Association for Clinical Simulation and Learning (INACSL)[22] and validated prior to the simulations. The validation process counted on the judgment of six experts, incorporated in the lines of research that contemplate children's health care in a hospital context. Validation took place in two rounds, with implementation of the changes suggested. To assess the agreement between the judges, the AC1statistic was used and, for all scenarios, the agreement coefficients were low in the first evaluation round (from 0.33 to 0.63, $p<0.001$). In the second round, after the adjustments made, agreement levels between 0.79 and 0.9 ($p<0.001$) were reached – obtaining values above 0.8 in most of the scenarios, indicating excellent and significant agreement.

The intervention (participation in the four validated scenarios) was conducted by the same facilitator (a professor from the institution proposing the study, with experience in pediatric clinical simulation), who went to the other institutions for data collection, taking the high-fidelity simulator with her, as well as the notebook with the scenarios. The other equipment/materials were provided by each institution, with those used in validation of the scenarios maintaining compliance. The scenarios had realistic environments, materials and equipment. A high-fidelity simulator (SimBaby), from Laerdal®, and an actress for the role of the mother (different for each institution, but trained in the same performance protocol) were used. The simulations lasted a total of approximately 20 minutes, being carried out in groups of up to 10 students, preceded by prebriefing and followed by debriefing. All the EG students participated in the four scenarios, but they took turns between acting in the scene (3-4 students) and watching/participating in the debriefing (6-7 students), guaranteeing performance in at least one scenario.

The simulations took place in different periods at each educational institution, aiming to evaluate a possible difference in the impact of the simulation on learning, depending on the moment of its execution. In University A, they were performed after the theoretical block and before the theoretical-practical activities in the field (in April 2017); in University B, they simultaneously followed the theoretical classes and theoretical-practical activities in the field (in May 2017); finally, in University C, the simulations were conducted after the theoretical block and the theoretical-practical activities in the field (in June 2017).

No additional intervention was applied to the CG, that is, the students only participated in the theoretical and theoretical-practical field activities offered in the academic disciplines (usual intervention, similar in the three institutions). Figure 1 presents the study flowchart.

The data were entered into Microsoft Excel 2010 spreadsheets by two independent typists, and consistency was assessed after collection was completed. Corrections were made in case of discordance between both typings, returning to the original instrument whenever necessary. For data analysis, characterization of the participants was initially performed by means of descriptive statistics. In the analytical phase, to better understand the factors related to the effect of simulation on knowledge acquisition, a multiple linear regression analysis was performed. At this stage, the difference between the score obtained by each participant in the EG and the CG was defined as the dependent variable at both application moments of the knowledge test (continuous variable). The following were considered as independent variables: gender (dichotomous variable – male/female), age (continuous variable), study group (dichotomous variable – EG/GC), educational institution (categorical variable – Institutions A, B and C), previous training in the Health area (variable collected as categorical and converted into dichotomous – yes/no), and previous experience in the Pediatrics or Neonatology area (variable collected as categorical and converted into dichotomous – yes/no).

Subsequently, in order to determine the contribution of satisfaction with the simulated clinical experiences to knowledge acquisition, another multiple linear regression was performed, although only with the EG. In this regression, the dependent variable continued to be the difference between the scores obtained in the pre- and post-tests; the set of independent variables was the same as the one described in the previous paragraph (except for the study group), plus the “satisfaction with the simulated practices” variable (continuous variable), measured by applying the Satisfaction with Simulated Clinical Experiences Scale[6].

It is important to emphasize that the analyses were in charge of a statistician using the R software, version 3.5.1, and adopting a significance level of $p<0.05$. For data normality evaluation, the Shapiro-Wilk test was used, while the Bartlett test was employed to evaluate the homoscedasticity hypothesis (homogeneous variance).

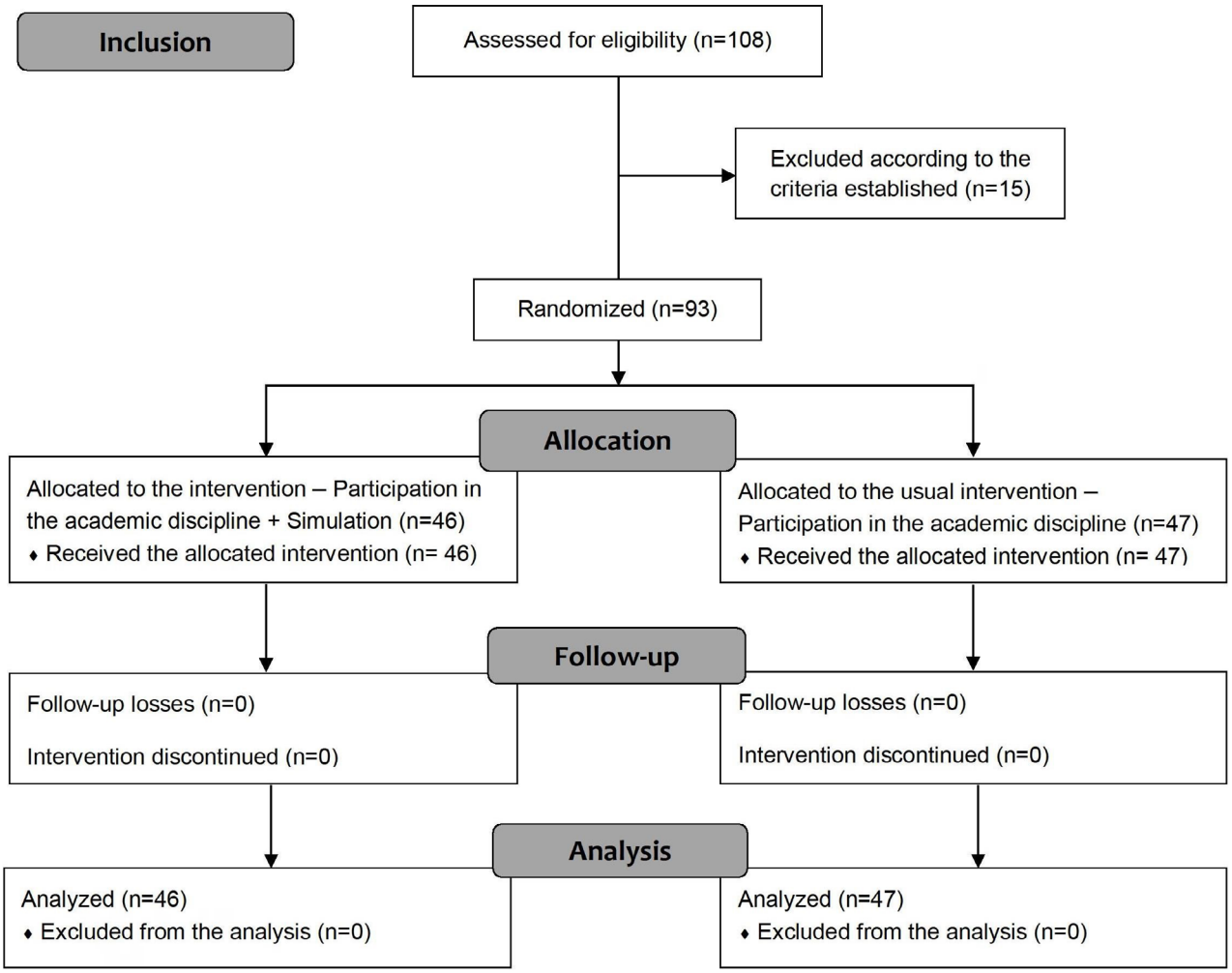

Figure 1 - Study flowchart (CONSORT standard).

In all its stages, this research observed the recommendations set forth in Resolution 466/12 of the National Health Council. The participants (students and experts) signed the Free and Informed Consent Form and received a copy. It is noteworthy that the students were informed that the clinical simulations would be offered, throughout the study and only to the experimental group, as activities that were not part of the academic discipline in which they were enrolled. As this intervention would be able to provide a benefit to the learning of the experimental group students in relation to the others, after data collection was completed, the researchers made the same clinical simulations available to all the other students enrolled in the aforementioned disciplines.

RESULTS

Of the 108 eligible undergraduate Nursing students, 93 participated in the study, with 15 participants excluded according to the criteria established. According to the characterization of the participants presented in Table 1, a fair distribution of cases and controls was observed. In addition to that, most of the participants were young, female, with no experience in the health area or previous training, and undergraduates from University B (as the course is annual at this institution, there were more students enrolled in the discipline).

Table 1 also shows that the mean score achieved in the knowledge pre-test was low, while in the post-test the mean score was relatively high. When comparing these scores, it is noticed that there was a significant difference between them. In relation to the satisfaction scale applied, on average the scores reached a high level, with the minimum value found already considered satisfactory (minimum value: 7.7 points; maximum value: 10 points).

Table 1 - Characterization of the participants, according to the study variables. Florianópolis, SC, Brazil, 2018. (n=93)

Variables studied	Descriptive statistics
Categorical variables	**n (%)**
Group	
Experimental	46 (49.46)
Control	47 (50.54)
Gender	
Male	6 (6.45)
Female	87 (93.55)
University	
University A	26 (27.96)
University B	47 (50.54)
University C	20 (21.51)
Experience in the area	
Yes	7 (7.53)
No	86 (92.47)
Previous training	
Yes	11 (11.83)
No	82 (88.17)
Numerical variables	**Mean (Standard Deviation)**
Age (years old)	23.26 (4.03)
Pre-test	15.22 (5.57)
Post-test	20.28 (3.96)
Difference*	4.63 (5.21)
Satisfaction scale	9.11 (0.67)

*Difference obtained through the following subtraction: Post-test score (–) Pre-test score.

It is noted that the Shapiro-Wilk Normality test was used to evaluate data normality, which presented *p*-value = 0.0012. As expected, multiple linear regression analysis was performed, considering the difference between the scores measured before and after the intervention as the dependent variable, by applying the pre- and post-tests. This analysis allowed knowing the factors associated with knowledge acquisition (increase in the test score), which are presented in Table 2.

When comparing the differences between the scores obtained by the students in the knowledge pre- and post-tests, it can be noticed that the EG participants obtained a mean score 4.04 points higher than the CG group. In addition to that, it is observed that the participants from University A had a mean score 3.89 points higher in the knowledge test than the participants from University B. It is also pointed out that 24.36% of the model variability is explained by the variables present in it.

Table 2 - Explanatory model for the acquisition of knowledge related to the Pediatric Nursing contents, among Nursing students. Florianópolis, SC, Brazil, 2018. (n=93)

Variables	Coefficient	Standard error	t test	p-value*
(Intercept)	5.1034	3.2017	1.5939	0.1155
Male gender	0.1360	2.1462	0.0633	0.9497
Experimental Group	4.0358	1.0949	3.6861	*0.0004*
Previous training	-1.4811	1.9893	-0.7445	0.4590
Experience in the area	0.1486	2.1292	0.0698	0.9446
University A†	3.8863	1.4120	2.7524	*0.0075*
University C†	-0.1484	1.4737	-0.1007	0.9201
Age	-0.1357	0.1420	-0.9560	0.3424
$R^{2‡}$	0.2436			

**p* = Significance level; †Considering University B as reference category; ‡R^2 = Coefficient of determination.

Regarding the evaluation of the effect of the students' satisfaction in the simulated clinical experiences for knowledge acquisition, another multiple linear regression was performed, though only considering the EG participants and introducing the satisfaction scale as an independent variable, in addition to the other independent variables from the previous regression, as shown in Table 3.

From the results presented in the Table 3, it can be seen that none of the variables was significantly associated with the outcome. In addition to that, only 25.93% of the model's variability is explained by the variables present in it. Finally, Bartlett's Homogeneity test was used to evaluate the homoscedasticity hypothesis (homogeneous variance), as shown in Table 4.

Based on the values presented, it is noticed that H0 was not rejected. Consequently, it is concluded that variance is homogeneous between the groups.

Table 3 - Explanatory model for the effect of satisfaction on the acquisition of knowledge related to the Pediatric Nursing contents, among undergraduate students subjected to the clinical simulation. Florianópolis, SC, Brazil, 2018. (n=93)

Variables	Coefficient	Standard Error	t test	p-value*
Intercept	1.5887	16.6017	0.0957	0.9245
Male gender	3.0993	3.6912	0.8397	0.4085
Previous training	-3.4861	2.5586	-1.3625	0.1843
Satisfaction scale	1.1167	1.7657	0.6325	0.5324
Experience in the area	0.8287	3.0962	0.2676	0.7910
University A†	1.5451	2.7853	0.5548	0.5836
University C†	-4.6814	2.7873	-1.6795	0.1046
Age	-0.1710	0.1727	-0.9900	0.3310
$R^{2‡}$	0.2593			

**p* = Significance level; †Considering University B as reference category; ‡R^2 = Coefficient of determination

Table 4 - Bartlett's Homogeneity test. Florianópolis, SC, Brazil, 2018. (n=93)

Variables	Statistics	Degrees	p-value*
Gender	1.8854	1	0.1697
EG†/CG‡	0.0243	1	0.8761
Previous training	0.3270	1	0.5674
Experience in the area	0.0031	1	0.9556
HEI	2.6706	2	0.2631

*p = Significance level; † EG = Experimental Group; ‡ CG = Control Group.

DISCUSSION

The results of this study point to a positive effect of high-fidelity clinical simulation on the acquisition of knowledge related to children's health, as the students who participated in the simulations obtained a significantly higher increase in the knowledge level than those who did not participate. Recent studies corroborate this finding, highlighting its benefits for the development of clinical and procedural skills, referring to the training of professionals in Pediatrics and Neonatology[13,23]. The use of simulations during the teaching-learning process is becoming a notorious and increasingly popular education method in Nursing teaching at the global level[24]. In addition to contexts already developed, where up to 25% of clinical learning takes place in a simulated environment[25], clinical simulation has also been used in countries with limited resources, in order to train Nursing students to act in the reduction of infant mortality[10].

It is known that, many times, the students do not have the opportunity to experience the themes inherent to children's health taught in theory and discussed in the classroom during their undergraduate studies[2,6]. The simulated clinical scenario helps in this aspect, as they will be able to train themselves through this active method, which makes it possible to experience multiple situations, favoring clinical reasoning and the association between theoretical content and practice[6,26]. In this perspective and corroborating the findings of the current study, a multicenter survey developed in South Korea showed that the combination of theoretical education with clinical simulation exerted a positive impact on Nursing students' knowledge and self-confidence, in relation to Pediatrics teaching[5]. With the simulation, the students manage to objectively perceive their evolution, thus enhancing awareness of their real capabilities[17].

Further corroborating the findings of the current study, the results of a meta-analysis indicated a superior effect of high-fidelity clinical simulation on cognitive learning results[24]. In addition to the increase in the knowledge level, a Turkish experimental study identified that clinical simulation exerted a positive impact on the development of Nursing students' attitudes in the management of epileptic seizures in children, which differentiated it from low-fidelity simulation[9]. Nursing students' clinical competence can also be improved through repeated experiences in clinical simulation, as pointed out by an Arab experimental study[18].

Considering that children represent a vulnerable population segment in which potential errors by inexperienced students can be even more harmful, the benefits contributed by simulation in terms of safety for pediatric patients and their families are highlighted[2]. It is suggested that simulation promotes the students' ability to independently provide a safe Nursing practice, as the safe care assumptions learned in theory can be easily forgotten in the face of practical obstacles[23]. In the simulated clinical experience, the students have the opportunity to deal with stressors that they will find in real children's care situations, such as crying and the need to adapt the communicative process with the children to

their developmental stage, as well as the presence of family members. The competences for children's care go beyond the technical and clinical aspects, requiring the ability to effectively communicate and collaborate with the family, from the perspective of the family-centered care philosophy, which underpins children's health care[2,11]. In this sense, by integrating different students' skills (procedural, clinical, relational and attitudinal), high-fidelity clinical simulation can greatly contribute to the teaching-learning process in Pediatric Nursing.

Regarding the "teaching institution" variable, belonging to the University A group presented a statistically significant effect on knowledge acquisition. In each locus, the simulations took place at a different moment; however, the same facilitator was present in all three institutions, using the same simulators and simulated scenarios, thus minimizing the possibility of bias. In this sense, we hypothesize that experiencing the clinical simulation after the theoretical block and before the theoretical-practical block (as was the case at University A) may have contributed to the positive results related to cognitive learning. It is believed that this result can be associated with the fact that simulation plays an important role in the students' transition to the real context, reducing the initial shock when entering the clinical practice, considering that current simulators offer a high level of realism[15]. In this sense, it may be that students who experience simulated clinical experiences in Pediatrics before starting the theoretical-practical activities in the field feel safer to experience learning situations in real contexts, with less stress and anxiety towards the children and their families, exerting a positive impacting on their learning[27]. However, we highlight that the difference observed can be attributed to other factors inherent to each institution, not evaluated in this study. No other studies were found that analyzed the ideal time to perform clinical simulation in Pediatric Nursing teaching, which limits the discussion on this finding and signals the need for further research studies.

Although the literature suggests that satisfaction with simulated clinical experiences has proved to be important for the teaching-learning process, as the participants feel motivated to be at the center of the process, favoring increased competence through simulated scenarios[16,28–29], satisfaction exerted no significant effect on knowledge acquisition in this study. It is believed that, due to the fact that the study population was reduced by half for this analysis, when only considering the EG (as only those who underwent the intervention answered the Satisfaction Scale), there may have been statistical power loss, which precluded detection of significant effects. This hypothesis is corroborated by the fact that the *university* variable, which reached statistical significance in the previous analysis, also lost significance in this complementary analysis. In addition to that, as presented in the characterization of the numerical variables, there were high values for the Satisfaction Scale variable, that is, most of the scores obtained in this scale were considered high (mean of 9.11, minimum of 7.7). Therefore, it is also possible that the satisfaction variable had no effect on knowledge acquisition, due to the fact that most of the students reported high satisfaction with the simulation strategy used, regardless of their performance on the knowledge test. This hypothesis is based on the fact that a general positive satisfaction is reported among students who participated in the simulations, either among those who acted directly in the scenario or among those who observed their peers' performance[5,30]. In this sense, a quasi-experimental study found a high level of satisfaction with the simulated clinical experience among the participating Nursing students, obtaining a mean of 4.86 points (standard deviation=0.28) in the satisfaction scale used, whose maximum score would be 5.0 points[19]. It is noted that, as it integrates learning – bringing together the theoretical bases and psychomotor skills, and contributing to critical thinking – high-fidelity clinical simulation motivates the students by enabling them to find in the simulators what is addressed in the theory[17].

Finally, it is noted that the effect of the "study group" and "university" variables observed on the outcome was independent from the other variables. That is, regardless of the students' gender and age and whether they have previous training or experience in the area, participating in the clinical

simulation after the theoretical activities and before the theoretical-practical activities (as was the case in University A) was decisive for a better performance in the knowledge test and, consequently, in cognitive learning related to Pediatric Nursing.

Despite all the relevant findings of this study, there are limitations. The first one is related to the students' participation modality in the scenarios, taking turns in direct performance in the scene, as well as to the participation, at the debriefing moment, of students who only watched the scene. However, despite that limitation, the high levels of overall satisfaction with the simulations corroborate a good simulated experience. Another limitation refers to the fact that knowledge acquisition was only considered by means of a questionnaire with closed questions, not validated, only evaluating short-term acquisition; that is, the assessment instrument did not consider all dimensions of learning and was not reapplied later to assess knowledge retention.

In addition to that, the coefficient of determination (R^2) was low in both regression analyses performed: around 25%. This result probably indicates that there are other variables potentially associated with the outcome that were not investigated by this study (however, it was decided to include few variables in the model, in compliance with the principle of parsimony). Furthermore, there may have been an improper specification of the functional relationship between the variables present in the model; in this sense, a non-linear model might be more suitable for the analysis.

Regarding selection of the participants, despite the fact that the invitation to the students was made by people with no relation of pedagogical authority (scholarship students, from other phases of the course or graduate studies), as the recruitment process was coordinated by the responsible professors of each center, it is worth noting this fact as a possible source of bias, although unlikely.

However, although there are limiting factors in this research, its results showed that the use of high-fidelity clinical simulations in Pediatric Nursing teaching reached high satisfaction levels among the students and contributed in a significant and effective way to their cognitive learning.

CONCLUSION

According to the results obtained through this study, it was possible to conclude that the participants' cognitive learning increased significantly after experiencing the high-fidelity clinical simulation as a teaching-learning tool. Therefore, the research points out that high-fidelity clinical simulation as a teaching strategy exerted a positive impact on the students' cognitive learning in the field of Pediatric Nursing.

On the other hand, the students' satisfaction with the simulated experiences did not exert a significant impact on the scores they obtained in the tests. Nevertheless, it was evident that the students were satisfied in participating of the situations related to children's health in a safe and simulated way. The importance of these findings for Pediatric Nursing teaching is highlighted since, from this experimental study with multiple data analysis, a positive and significant effect of simulation on knowledge acquisition was proven.

Finally, it is proposed to develop future research studies on the topic, which will assist in the discussion of issues that go beyond the limits of the current study, with a view to composing a robust literature, which supports the use of high-fidelity simulation in the training of nurses, in the context of Pediatrics. Specifically, studies with larger populations that investigate other variables potentially associated with the outcome, by means of non-linear methods. It is recommended that, in these future studies, not only short-term knowledge acquisition but also long- and medium- term retention of learning be evaluated.

REFERENCES

1. Malmström B, Nohlert E, Ewald U, Widarsson M. Simulation-based team training improved the self-assessed ability of physicians, nurses and midwives to perform neonatal resuscitation. Acta Paediatri [Internet]. 2017 [cited 2021 Oct 29];106(8):1273-9. Available from: https://doi.org/10.1111/apa.13861
2. Teles MG, Mendes-Castillo AMC, Oliveira-Kumakura ARS, Silva JLG. Clinical simulation in teaching pediatric nursing: students' perception. Rev Bras Enferm [Internet]. 2020 [cited 2021 Oct 29];73(2):e201807201. Available from: https://doi.org/10.1590/0034-7167-2018-0720
3. Fonseca LMM, Aredes NDA, Fernandes AM, Batalha LMC, Apóstolo JMA, Martins JCA, et al. Computer and laboratory simulation in the teaching of neonatal nursing: innovation and impacto of learning. Rev Lat Am Enfermagem [Internet]. 2016 [cited 2021 Oct 29];24:e2808. Available from: https://doi.org/10.1590/1518-8345.1005.2808
4. Wagner M, Heimberg E, Mileder LP, Staffler A, Paulun A, Löllgen RM. Status quo in pediatric and neonatal simulation in four central European regions: the DACHS survey. Simul Healthc [Internet]. 2018 [cited 2021 Oct 29];13(4):247-52. Available from: https://doi.org/10.1097/SIH.0000000000000296
5. Lee M-N, Kang K-A, Park S-J, Kim S-J. Effects of pre-education combined with a simulation for caring for children with croup on senior nursing students. Nurs Health Sci [Internet]. 2017 [cited 2021 Oct 29];19(2):264-72. Available from: https://doi.org/10.1111/nhs.12340
6. Sanders MKK, Barr JL, Goldstein LA. Development and implementation of unfolding pediatric simulations. J Nurs Educ [Internet]. 2020 [cited 2021 Oct 29];59(2):107-10. Available from: https://doi.org/10.3928/01484834-20200122-10
7. Aldridge MD. Teaching nursing students the care of a patient with end stage renal disease in a pediatric nursing theory course: a comparison of two instructional methods. Nephrol Nurs J [Internet]. 2019 [cited 2021 Oct 29];46(6):605-10. Available from: https://www.proquest.com/openview/494c8b4f32ca1aca68b3d2a423cb6dbe/1?cbl=45638&pq-origsite=gscholar&accountid=26642
8. Cole MA, Foito K. Pediatric end-of-life simulation: preparing the future nurse to care for the needs of the child and family. J Pediatr Nurs [Internet]. 2019 [cited 2021 Oct 29];44:e9-12. Available from: https://doi.org/10.1016/j.pedn.2018.09.005
9. Kahraman A, Gümüş M, Binay Ş, Zengin D, Uzşen H, Sevgili SA, et al. The effect of simulation-based education on childhood epileptic seizure management knowledge, skills, and attitudes of nursing students. Epilepsy Behav [Internet]. 2019 [cited 2021 Oct 29];100(A):106497. Available from: https://doi.org/10.1016/j.yebeh.2019.106497
10. Phiri EC, Chaputula B, Shawa E, Chiaravalli J, Sigalet E, Gabriel J, et al. A simulation scenario focused on resuscitation of a young infant (neonate) for nurses and midwives in Malawi, a limited resource country. Cureus [Internet]. 2018 [cited 2021 Oct 29];10(5):e2673. Available from: https://doi.org/10.7759/cureus.2673
11. Fitzgerald M, Ward J. Using standardized actors to promote family-centered care. J Pediatr Nurs [Internet]. 2019 [cited 2021 Oct 29];45:20-5. Available from: https://doi.org/10.1016/j.pedn.2018.12.002
12. Zimmermann E, Alfes CM. Simulating the role of the parent: promoting family-centered nursing care. Nurs Educ Perspect [Internet]. 2019 [cited 2021 Oct 29];40(2):121-2. Available from: https://doi.org/10.1097/01.NEP.0000000000000339
13. Sadovnikova A, Chuisano SA, Ma K, Grabowski A, Stanley KP, Mitchell KB, et al. Development and evaluation of a high-fidelity lactation simulation model for health professional breastfeeding education. Int Breastfeed J [Internet]. 2020 [cited 2021 Oct 29];15(1):8. Available from: https://doi.org/10.1186/s13006-020-0254-5

14. Nold L, Deem MJ. A simulation experience for preparing nurses to address refusal of childhood vaccines. J Nurs Educ [Internet]. 2020 [cited 2021 Oct 29];59(4):222-6. Available from: https://doi.org/10.3928/01484834-20200323-09

15. Presado MHCV, Colaço S, Rafael H, Baixinho CL, Félix I, Saraiva C, et al. Learning with high fidelity simulation. Ciênc Saúde Colet [Internet]. 2018 [cited 2021 Oct 29];23(1):51-9. Available from: https://doi.org/10.1590/1413-81232018231.23072017

16. Souza EFD, Silva AG, Silva AILM. Active methodologies for graduation in nursing: focus on the health care of older adults. Rev Bras Enferm [Internet]. 2018 [cited 2021 Oct 29];71 Suppl 2:920-4. Available from: https://doi.org/10.1590/0034-7167-2017-0150

17. Baptista RCN, Martins JCA, Pereira MFCR, Mazzo A. Students' satisfaction with simulated clinical experiences: validation of an assessment scale. Rev Lat Am Enfermagem [Internet]. 2014 [cited 2021 Oct 29];22(5):709-15. Available from: https://doi.org/10.1590/0104-1169.3295.2471

18. Guerrero JG, Hafiz AH, Eltohamy NAE, Gomma N, Jarrah IA. Repeated exposure to high-fidelity simulation and nursing interns' clinical performance: impact on practice readiness. Clin Simul Nurs [Internet]. 2021 [cited 2022 Apr 06];60:P18-24. Available from: https://doi.org/10.1016/j.ecns.2021.06.011

19. Guerrero JG, Ali SAA. The acquired critical thinking skills, satisfaction, and self confidence of nursing students and staff nurses through high-fidelity simulation experience. Clin Simul Nurs [Internet]. 2022 [cited 2022 Apr 6];64:P24-30. Available from: https://doi.org/10.1016/j.ecns.2021.11.008

20. Assis MS, Nascimento JSG, Nascimento KG, Torres GAS, Pedersoli CE, Dalri MCB. Simulation in nursing: production of the knowledge of the graduate courses in Brazil from 2011 to 2020. Texto Contexto Enferm [Internet]. 2021 [cited 2021 Oct 29];30:e20200090. Available from: https://doi.org/10.1590/1980-265X-TCE-2020-0090

21. Sousa VD, Driessnack M, Mendes IAC. An overview of research designs relevant to nursing: Part 1: quantitative research designs. Rev Lat Am Enfermagem [Internet]. 2007 [cited 2021 Oct 29];15(3):502-7. Available from: https://doi.org/10.1590/S0104-11692007000300022

22. INACSL Standards Committee. INACSL standards of best practice: Simulation^{SM} simulation design. Clin Simul Nurs [Internet]. 2016 [cited 2022 Feb 7];12 Suppl 1:S5-12. Available from: https://doi.org/10.1016/j.ecns.2016.09.005

23. Bowling AM. The effect of simulation on skill performance: a need for change in pediatric nursing education. J Pediatr Nurs [Internet]. 2015 [cited 2021 Oct 29];30(3):439-46. Available from: https://doi.org/10.1016/j.pedn.2014.12.010

24. Kim J, Park J-H, Shin S. Effectiveness of simulation-based nursing education depending on fidelity: a meta-analysis. BMC Med Educ [Internet]. 2016 [cited 2021 Oct 29];16:152. Available from: https://doi.org/10.1186/s12909-016-0672-7

25. Staty LC, Merriman C, Ricketts B, Morton S, Simpson T. Recognizing and managing a deteriorating patient: a randomized controlled trial investiagion the effectiveness of clinical simulation in improving clinical performance in undergraduate nursing students. J Adv Nurs [Internet]. 2015 [cited 2021 Oct 29];71(11):2563-74. Available from: https://doi.org/10.1111/jan.12722

26. Carvalho EC, Oliveira-Kumakura ARS, Morais SCRV. Clinical reasoning in nursing: teaching strategies and assessment tools. Rev Bras Enferm [Internet]. 2017 [cited 2021 Oct 29];70(3):662-8. Available from: https://doi.org/10.1590/0034-7167-2016-0509

27. Kubin L, Wilson CE. Effects of community volunteer children on student pediatric assessment behaviors. Clin Simul Nurs [Internet]. 2017 [cited 2021 Oct 29];13(7):303-8. Available from: https://doi.org/10.1016/j.ecns.2017.04.011

28. Fernandes AKC, Ribeiro LM, Brasil GC, Magro MCS, Hermann PRS, Ponce de Leon CGRM, et al. Simulation as a strategy for learning in pediatrics. REME [Internet]. 2016 [cited 2021 Oct 29];20:e976. Available from: https://doi.org/10.5935/1415-2762.20160046

29. Negri EC, Mazzo A, Martins JCA, Pereira GA Junior, Almeida RGS, Pedersoli CE. Clinical simulation with dramatization: gains perceived by students and health professionals. Rev Lat Am Enfermagem [Internet]. 2017 [cited 2021 Oct 29];25:489-97. Available from: https://doi.org/10.1590/1518-8345.1807.2916

30. Kelly MA, Hager P. Informal learning: relevance and application to health care simulation. Clin Simul Nurs [Internet]. 2015 [cited 2021 Oct 29];11(8):376-82. Available from: https://doi.org/10.1016/j.ecns.2015.05.006

NOTES

ORIGIN OF THE ARTICLE

Extracted from the Course Completion Paper - Effect of clinical simulation on Pediatric Nursing Students' learning and satisfaction, presented to the Undergraduate Nursing Course of *Universidade Federal de Santa Catarina*, in 2018.

CONTRIBUTION OF AUTHORITY

Conception of the study: Pina JC, Okido AC, Fonseca LMM.
Data collection: Nadler CF, Pina JC, Schmidt SQ, Okido ACC, Fonseca LMM, Rocha PK, Anders JC.
Data analysis and interpretation: Nadler CF, Pina JC, Okido ACC, Fonseca LMM.
Discussion of the results: Nadler CF, Pina JC, Okido ACC, Fonseca LMM, Nascimento KC, Oliveira SN, Anders JC.
Writing and/or critical review of the content: Nadler CF, Pina JC, Schmidt SQ, Okido ACC, Fonseca LMM, Rocha PK, Anders JC, Nascimento KC, Oliveira SN.
Review and final approval of the final version: Nadler CF, Pina JC, Schmidt SQ, Okido ACC, Fonseca LMM, Rocha PK, Anders JC, Nascimento KC, Oliveira SN.

FUNDING INFORMATION

This study was financed by the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* - Brazil (CAPES) - Finance Code 001.

APPROVAL OF ETHICS COMMITTEE IN RESEARCH

Approved by the Ethics Committee in Research of the *Universidade Federal de Santa Catarina*, opinion No.1,557,128/2016, Certificate of Presentation for Ethical Appreciation 55177916.3.0000.0121.

CONFLICT OF INTEREST

There is no conflict of interests.

HISTORICAL

Received: December 02, 2021.
Approved: May 04, 2022.

CORRESPONDING AUTHOR

Juliana Coelho Pina
pina.juliana@ufsc.br