Effectiveness of simulation in teaching immunization in nursing: a randomized clinical trial*

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Objective: to evaluate the effectiveness of the clinical simulation on the cognitive performance of nursing students in adult immunization scenarios in the context of Primary Health Care.

Method: a controlled and randomized pre-test and post-test clinical trial applied to random intervention and control groups. 34 undergraduate nursing students were selected and divided into two groups: classes with active participation of students and skills training (control); and classes with active participation of students, skills training, and clinical simulation (intervention). Results: the students in the intervention group performed better than those in the control group in the four assessments of cognitive performance, with statistical significance in the assessments of immediate (p=0.031) and late (1-20 days) (p=0.031) knowledge. Conclusion: from the simulation, students learn more in the short and medium terms. The information learned is retained for longer and the students are better prepared for the professional practice.

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Descriptors: Simulation; Students; Nursing Education; Immunization; Education; Primary Health Care.

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† In memoriam.
Introduction

In Brazil, the National Immunization Program (Programa Nacional de Imunização, PNI) is recognized for its great contribution in reducing the indicators of morbidity and mortality caused by vaccine-preventable diseases. In addition, in the international scenario, it is considered the program that offers the largest number of free immunobiologics\(^1\).

It is important to highlight the important role of nurses to achieve the good results presented by the PNI since, within the scope of health units and services, these professionals contribute positively to processes that enable the immunization of the population. Some of these professionals’ attributions include the following: management of the vaccine room, training and coordination of the nursing staff for maintenance and administration of immunobiologics, application of doses of immunobiologics, appointments, planning and development of strategies to expand and enable access to immunobiologics\(^2\).

In identifying and recognizing the duties and contribution of professional nurses in making the processes that lead to immunization feasible and effective, it is important to consider the need for qualification of the nursing students during graduation. For example, practical internships by themselves do not guarantee that the students will be prepared to deal with the different situations commonly encountered in the realities of the health services, especially in the vaccination room.

When entering the Basic Health Units (BHUs), for example, the newly-graduated nurse has the same responsibilities as the other nurses in these services. From this perspective, failures during their training can compromise the execution of tasks and culminate in unwanted performance and damage to the population’s health\(^2\).

Therefore, it is necessary to rethink topics such as the curriculum, the contents, and methodological approaches adopted in teaching in the context of Primary Health Care (PHC). In this way, the Pan American Health Organization (PAHO) and the World Health Organization (WHO) have encouraged countries to promote reforms and improvements in the education of health professionals focused on PHC, especially in the Latin American context\(^3\).

However, in the education context, more traditional clinical setting\(^\text{6-7}^\) uses technologies to replicate scenarios that simulate clinical experiences with the results of the students’ performance in adult immunization scenarios in the context of the Primary Health Care.

Method

This is a randomized pre-test and post-test clinical trial applied to randomized intervention and control groups. The study was conducted in a federal public university in the Northeast of Brazil, between May and June 2017.

It was approved by the Research Ethics Committee under protocol No. 1,958,827 and CAAE No. 64874817.3.0000.5537. After approval, it was registered on the Brazilian Clinical Trials Registry platform under protocol RBR-9sgr6b, UTN number: u1111-1195-2580.

The students participating in the study were regularly enrolled in the 5th to 9th semester of the Nursing Undergraduate course. The option to prioritize these students was due to their availability to take the course that made data collection possible. The initial non-probability convenience sample was of 58 students.
After consolidating the instrument of characterization of the population in an electronic spreadsheet, the data were forwarded to an independent statistician for randomization. In this procedure, the following variables were taken into account: gender, age, Academic Performance Index (Índice de Rendimento Acadêmico, IRA), work experience in the area of PHC, and diagnosis of the preferred representational system. The researcher had no interference in the designation of the individuals allocated to the two groups.

After designation, chi-square (X²) and Fisher’s exact tests were performed, for a significance level of 5%. To verify the normality of the data, the Shapiro-Wilk test was applied, also assigning a significance level of 5%. It was evidenced that age and IRA did not have a normal distribution, therefore, non-parametric tests were applied to these variables. Using the Mann-Whitney test, for a significance level of 5%, no evidence of statistical difference in age and IRA was found between the selected groups.

The following inclusion criteria were used: being a regularly enrolled undergraduate nursing student and having at least 75% attendance during the course offered. Students who were not present at the other times of intervention and application of the research instruments, scholarship students and collaborators who contributed to the execution of the study were excluded. After applying the inclusion criteria, the final sample consisted of 34 students, as detailed in Figure 1.

![Flowchart](chart.png)

Adapted from CONSORT (2010)

Figure 1 – Follow-up diagram

After randomization, the students participated in a 40-hour classroom course on adult immunization. The control group participated in the course in modality 1: (classes with active participation of students, and skills training); while the intervention group was directed to modality 2 (classes with active participation of students, skills training, and realistic simulation). Figure 2 details the strategies, learning objectives, and resources used in the interventions relevant to the training course that originated the data collection.
The lecture classes were created from the contents provided and guided by the course syllabus. The lesson plan for each meeting was made available in advance, as well as a textbook with the references that served as the basis for each meeting. The references provided were taken from the PNI.

For skills training, checklist guides were made available. Four stations were set up in the nursing laboratory. On the occasion, the students were divided into small groups – 4 to 5 students – and took turns between the stations. After the consolidation of activities at each station, the researchers, a group of three nursing professors, provided feedback to the participating groups.

For the intervention group, the simulation scenarios were built from the instruments and references available in the literature from the models of the Tübingen University Hospital (TuPASS), Germany, and of the Anhembi Morumb University, Brazil. In addition, the dimensions of the S.M.A.R.T structure (objectives, measurement of results, achievement of objectives, realism, and time) were taken into account. The scenarios were tested and validated by specialists for appearance and content. The specialists consulted were the researchers of the project.

The scenarios were previously tested. For the simulations, the standard-patient tool was used, with actors trained to act and reproduce user behaviors in different situations and health care establishments. The three scenarios were executed on the same day.

At the end of the simulations, the intervention group participated in the discussion and reflection, using the debriefing technique, stage in which all the students can discuss about the experienced scene. At that moment, the students had the opportunity to explore the scenarios experienced in order to help them consolidate the information acquired, identify and reflect on areas in which they could improve. Each session lasted 30 minutes. With regard to the time of the session, it is important that it is not too long. It is recommended to be the double or triple of the scenario execution time.

The researchers created a specific knowledge test about immunization of adults in the context of PHC, with 10 essay questions and an overall value of 10.0 points (1.0 per question). The test was applied in the intervention and control groups in four moments, namely: beginning of the course (Pre), immediately after the end of the course (Post 1), 20 days (Post 2) and 40 days (Post 3) after the course ended.

The tests were corrected by the researchers. The evaluation was guided by a solved question paper. The questions and corresponding expected answers were built from the contents and materials made available for the training course. The final score – in each evaluation – was established based on the mean assigned by two independent evaluators.

Data was analyzed in SPSS (Statistical Package for Social Sciences), version 24. For the characterization of the socio-demographic profile and evaluation of the course, descriptive statistics were used. In the analysis of cognitive performances, the Mann-Whitney test was used, for a significance level of 5%.

### Results

Most of the students who participated in the study were female (79.6%) and young adults. The most frequent age group was between 21 and 23 years old, with a mean of 22.3 years old (maximum of 34 and minimum of 18).

Regarding cognitive performance, Table 1 shows the values of the previous, immediate and late (20 and 40 days) evaluations. The intervention...
group (with simulation) had the best performance in all the evaluations, with an initial mean of 3.38 (maximum of 7.40 and minimum of 0.50) and a final mean of 6.55 (maximum of 9.00 and minimum of 3.00).

Although with lower performances, the students in the control group also showed an improvement during the four assessments, with an initial mean of 3.35 and a final one of 6.01. Both groups obtained increasing rates of performance in the short, medium and long terms.

The students in the intervention group (IG) had a better performance compared to the control group (CG) in the Post 1 (p-value = 0.031) and Post 2 (p-value = 0.031) assessments. This result suggests that, with the simulation, the students learn more in the short term and that the information learned is retained for longer.

No statistical significance was found in the previous (Pre) (p-value = 0.586) and Post 3 (p-value=0.231) assessments. Table 2 shows the mean values of cognitive performance in the four assessments of the CG and IG and the statistical significance from the Mann-Whitney’s U test.

Table 1 – Previous, immediate and late (Post 1 and Post 2) performances of the students in the control and intervention groups in the cognitive assessment test. Natal, RN, Brazil, 2017

|        | CG1 (n=17) | IG1 (n=17) |
|--------|------------|------------|
| Mean   | 3.35       | 3.38       |
| SD     | 4.22       | 2.80       |
| Median | 3.80       | 2.90       |
| Max    | 0.90       | 1.47       |
| Min    | 2.23       | 6.30       |
|        | 7.40       | 8.40       |
|        | 0.50       | 3.10       |

*CG = Control Group; †IG = Intervention Group; ‡SD = Standard Deviation; §Max = Maximum; ||Min = Minimum

Table 2 – Mean cognitive performance (previous, immediate and Post 1 and Post 2) of the students in the control and intervention groups, and statistical significance. Natal, RN, Brazil, 2017

|        | CG1 | IG1 | CG1 | IG1 | CG1 | IG1 | CG1 | IG1 |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|
| Mean   | 3.35| 3.38| 5.04| 6.07| 5.55| 6.35| 6.01| 6.55|
| Mann-Whitney’s U | 128.00 | 82.50 | 82.50 | 109.00 |
| Z‡   | -0.569 | -2.138 | -2.139 | -1.223 |
| p-value§ | 0.586 | 0.031 | 0.031 | 0.231 |

*CG = Control Group; †IG = Intervention Group; ‡Z = Z test; §Mann-Whitney’s test

Discussion

The study evaluated the effectiveness of the clinical simulation in the cognitive performance of nursing students in adult immunization scenarios in the context of PHC. It is known that Nursing has essential roles to guarantee the processes related to immunization, such as management of the vaccine room, organization and disposal of materials and supplies, conservation of immunobiologicals, and the nursing conduct(16).

Although the relevance and contribution of the nursing professionals in the context of immunization are recognized, nursing errors are recurrent, such as the Adverse Events Following Immunization (AEFIs). Reports of these events after immunization are considered relevant worldwide(16).

A Brazilian study that analyzed the occurrence of AEFIs due to immunization errors showed a significant increase in cases over a period of ten years. Thus, a disturbing scenario is observed since this type of error, linked to the nursing practice, can be avoidable(17). This result raises concern as errors can interfere with the population’s confidence and, consequently, in the control of vaccine-preventable diseases(16-17).

It is known that the PNI is the largest immunization program in the world. In this perspective, the offer and expansion of the number of immunobiologicals, the countless vaccination teams, the inadequate practices of conservation and administration of doses, and the constant updates in immunization schedules can contribute to errors(17).

In this perspective, it is urgent to think about actions that promote safety and quality in immunization. Thus, thinking about teaching and learning strategies that promote meaningful learning is relevant and current(17-18).

Several studies indicate strategies for improving safety in the scope of immunization, such as the use of protocols(15) and improving the education
of both\textsuperscript{(18)} students and professionals through continuing education\textsuperscript{(19)}.

In the educational field, educational approaches that consider practical experiences have a substantial character. Thus, it is essential to rethink nursing education, especially when it comes to revisiting old assumptions, such as that the student’s learning is mainly related to the amount of information received from the teacher. The students are deemed to build their own cognitive structures and, from their interaction with the environment, to consolidate their knowledge\textsuperscript{(20)}.

In this way, it is understood that learning becomes significant when there are relations, built by the students, between previous knowledge and new knowledge. Meanwhile, it is considered that when these relationships occur, there is effective, consolidated, and lasting learning\textsuperscript{(21)}.

Significant learning is identified by the student when the acquired knowledge has applicability in the work practice\textsuperscript{(22)}. Thus, the clinical simulation, as it has a realistic nuance, can be a teaching strategy to promote more consistent and significant knowledge\textsuperscript{(23)}.

In this research, the students who participated in the training with the simulation had better performances – in the short and medium terms – when compared to those who were exposed to traditional teaching strategies.

Accordingly, different research studies present results similar to those found in this study. A research conducted with 58 undergraduate nursing students, which aimed to verify the effectiveness of the clinical simulation in sponge bath teaching, identified that the students who had an education associated with simulations had higher scores in the immediate and late (30 days after training with simulation) post-tests when compared to the rest\textsuperscript{(22)}.

In contrast, a quasi-experiment conducted with 110 students in basic life support training evaluated the students’ knowledge and self-efficacy before and after the educational interventions. The results showed that there was no statistical significance in the acquisition and retention of knowledge between traditional teaching methods (Power Point presentation and demonstration) and high-fidelity simulation. However, the scores of the group with simulation were higher, both in terms of acquisition and of retention\textsuperscript{(24)}.

A randomized, controlled and blind intervention study carried out with 34 nursing students evaluated the effectiveness of the clinical simulation in teaching how to evaluate deteriorating patients. It was observed that the experimental group had better scores in the post-test. In addition, the study identified the impacts of the clinical simulation and how effective it was compared to traditional teaching for developing skills to evaluate deteriorating patients\textsuperscript{(25)}. The results of this research corroborate those found in the previous study by comparing and showing how effective the clinical simulation is compared to conventional teaching methods.

An experimental study, with pre- and post-tests, conducted with 85 nursing students, intended to evaluate the effect of a private simulation experiment on drug administration and identified that the simulation increased the student’s level of competence when compared to traditional teaching\textsuperscript{(26)}.

Thus, traditional teaching methodologies, used occasionally, do not support quality education. In the context of nursing education, as science evolves, teaching and learning must be improved to keep up with the current health needs and changes\textsuperscript{(27)}. In addition, the premise for having a quality training of nurses demands adequate and proper infrastructure, structured syllabus, and partnerships\textsuperscript{(28)}.

When thinking about quality training and its requirements, one should consider the current job market, new technologies, current health demands, patient safety, and ethical issues\textsuperscript{(27)}. To this end, it is necessary to use teaching and learning methodologies that consider these aspects, such as the clinical simulation, which is seen as a potential teaching and learning strategy as it is based on the aforementioned factors.

Regarding the stages of the simulation strategy and its potential for meaningful learning, the student’s participation in the debriefing stands out. In this phase, students can be guided in identifying gaps in the performance of tasks and their improvement\textsuperscript{(28-30)}. In summary, there is the possibility of reflecting on the actions and on improving learning for future situations\textsuperscript{(31)}.

Compared to other teaching strategies, the clinical simulation has the advantage of promoting organized and planned knowledge, where the student is the active participant in this process. Combined with the simulation, this structure has a greater impact on the students compared to feedback\textsuperscript{(32)}. Questioning, exchange of experiences and knowledge about the experiences, the performance, the strategies for improving the actions and the transposition of this experience into work practice are part of this teaching and learning strategy.

High-quality simulated learning has the potential to be transformative, to engage emotions and to enable students to be directly involved in activities that reflect experiences in the workplace\textsuperscript{(33)}.\textsuperscript{(33)}
The use of simulation has been increasingly present in nursing education\(^{34}\). Several research studies report benefits and acquisition of skills and abilities such as empathy, articulation between theory and practice, reduction of errors, decision making, leadership development, improvement in the health service processes and even increase in the levels of satisfaction, autonomy and self-confidence\(^{35-41}\).

Some benefits of the simulation include flexibility of access – without depending on the scheduling of days and hours in the clinical practice; a safe setting, both physically and psychologically, so that students can develop skills and make mistakes without causing damage to the users; the prior use of technologies that exist in the real practice; and the possibility of experiencing situations that are not commonly found in the practice – due to the impossibility of diagnoses, patient discharge, and/or lack of opportunities\(^{42}\).

Given the recognition of the possibilities and benefits of using the simulation in the context of teaching and learning in health and nursing, the WHO recommends its use in this context\(^{43}\).

Most of the conducted and disseminated studies that address the use of the simulation in nursing education are focused on urgencies and clinical emergencies. The research studies on high-fidelity simulation and the use of standard-patients in nursing and in the context of PHC is still incipient\(^{44}\). In this sense, better designed studies contribute to the production of evidence, to the expansion of the applicability of its use, and to the improvement of the quality of vocational training\(^{45}\).

While recognizing the relevance of training skills related to immunization practices, both in undergraduate courses and for the work practice, these trainings are not usually available in adequate formats in the educational institutions.

By comparing the effectiveness of the simulation with traditional teaching methods, this study contributes to reduce the gap in the national and international literature. In addition, evidence of the effectiveness of this strategy in nursing education can provide theoretical support for discussions about improvements in the educational process and the insertion of this strategy in the syllabus of nursing students.

It also contributes to the advancement of knowledge in the area of simulation and in the nursing field, as it uses an experimental design with a very considerable follow-up period. In researching this area of knowledge, most studies that use this design and are found in the literature have relatively short follow-up times.

One of the limitations of the study was the scarcity in the literature regarding research studies that could serve as a comparison and that mentioned the use of the simulation in the context of PHC – specifically about immunization. Another limitation was the number of losses during follow-up. As it originated from an extension course with several meetings and activities, the students had difficulties in reconciling it with other mandatory academic activities.

**Conclusion**

The students in the experimental group had better performances in the assessment of cognitive knowledge in all the tests when compared to the students in the control group. There was statistical significance in the Post 1 \((p = 0.031) – \) immediately after the intervention – and Post 2 \((p = 0.031) – \) 20 days after the intervention. Thus, in this study, the clinical simulation promoted a more effective learning (from the point of view of cognitive performance) among nursing students in adult immunization scenarios in the context of PHC.

**References**

1. Ministério da Saúde (BR). Programa Nacional de Imunizações: 30 anos. Brasília: Ministério da Saúde; 2003. [Acesso 28 out 2018]. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/livro_30_anos_pni.pdf
2. Costa RRO. Eficácia da simulação realística no ensino de imunização de adultos no contexto da graduação em enfermagem [tese]. Natal (RN): Universidade Federal do Rio Grande do Norte; 2018 [Acesso 14 jan 2020]. Disponível em: https://repositorio.ufrn.br/jspui/handle/123456789/25750
3. Pan American Health Organization. Human resources for health: increasing access to qualified health workers in primary health care-based health systems. Washington: OPS; 2013 [cited Oct 28, 2018]. Available from: http://iris.paho.org/xmlui/handle/123456789/4441.
4. Jeffries P. The good news. Simulations work, so now what? J Nurs Educ. 2015 [citedFeb 22, 2018];54(11):603-4. Available from: http://www.healio.com/doiresolver?doi=10.3928/0148 4834-20151016-10
5. Medeiros MSN, Medeiros SM, Costa RRO, Araújo MS, Medeiros KCMC. Teaching and learning strategies used in education of topics of primary health in the nursing graduation: an integrative literature review. Rev Enferm Atual. 2017 Jun [cited Oct 28, 2018];83:78-85. Available from: http://revistaenfermagematual.com/index.php/revistaestrategiasdeensino
6. Cassiani SHB, Wilson LL, Mikael SSE, Peña LM, Grajales RAZ, McCreary LL, et al. The situation of nursing education in Latin America and the Caribbean towards universal health. Rev. Latino-Am Enfermagem. 2017 May [cited Oct 28, 2018];25:e2913. doi: http://dx.doi.org/10.1590/1518-8345.2232.2913

7. Costa RRO, Medeiros SM, Martins JCA, Enders BC, Lira ALBC, Araujo MS. Simulation in nursing teaching: a conceptual analysis. Rev Enferm Cent-Oest Min. [Internet]. 2018 [cited Oct 28, 2018]; 8:e1928. doi: http://dx.doi.org/10.19175/recom.v7i0.1928

8. Parker RA, McNeill J, Howard J. Comparing pediatric simulation and traditional clinical experience: student perceptions, learning outcomes, and lessons for faculty. Clin Simul Nurs. [Internet]. 2015 [cited Feb 22, 2018];11(3):188-93. doi: https://doi.org/10.1016/j.ecns.2015.01.002

9. Doolen J, Mariani B, Atz T, Horsley TL, O’Rourke J, McAffee K, et al. High-fidelity simulation in undergraduate nursing education: a review of simulation reviews. Clin Simul Nurs. [Internet]. 2016 [cited Feb 22, 2018];12(7):290-302. Available from: https://www.nursingsimulation.org/article/S1876-1399(16)00012-8/abstract

10. Ramm D, Thomson A, Jackson A. Learning clinical skills in the simulation suite: the lived experiences of student nurses involved in peer teaching and peer assessment. Nurse Educ Today. [Internet]. 2015 [cited Feb 22, 2018];35(6):823-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25697946

11. CONSORT. Flow diagram. 2010 [cited Feb 22, 2018]. Available from: http://www.consort-statement.org/download/Media/Default/Downloads/CONSORT%202010%20Flow%20Diagram.doc

12. National League for Nursing. Simulation innovation resource center. 2013 [cited Oct 28, 2018]. Available from: http://sirc.nln.org/mod/glossary/view.php?id=183.

13. International Nursing Association for Clinical Simulation. INACSL Standards of best practice: Simulation™ Simulation Design. [Internet]. 2016 [cited Feb 22, 2018]. Available from: https://www.inacsl.org/inacsl-standards-of-best-practice-simulation/

14. Arthur C, Levett-Jones T, Kable A. Quality indicators for the design and implementation of simulation experiences: a Delphi study. Nurse Educ Today. 2013 [cited Feb 22, 2018];33:1357-61. doi: http://dx.doi.org/10.1016/j.nedt.2012.07.012

15. Almeida RGS, Mazzo A, Martins JCA, Coutinho VRD, Jorge BM, Mendes IAC. Validation to Portuguese of the Debriefing Experience Scale. Rev Bras Enferm. [Internet]. 2016 [cited Aug 26, 2019];69(4):705-11. doi: http://dx.doi.org/10.1590/0034-7167.2016690413i

16. Medeiros SG, Lima Neto AV, Saraiva CO, Barbosa ML, Santos VE. Safety evaluation in vaccine care: elaborating and validating a protocol. Acta Paul Enferm. [Internet]. 2019 [cited Aug 26, 2019];32(1):53-64. doi: http://dx.doi.org/10.1590/1982-0194201900008

17. Linheira-Bisetto LH, Ciosak SI. Analysis of adverse events following immunization caused by immunization errors. Rev Bras Enferm. [Internet]. 2017 Feb [cited Aug 26, 2019];70(1):87-95. doi: http://dx.doi.org/10.1590/0034-7167-2016-0034

18. Martins JRT, Viegas SMF, Oliveira VC, Rennó HMS. Vaccination in everyday life: experiences indicate Permanent Education. Esc Anna Nery. [Internet]. 2019 [cited Aug 26, 2019];23(4):e20180363. doi: http://dx.doi.org/10.1590/2177-9465-ean-2018-0365

19. Araújo TM, Souza FO, Pinho PS. Vaccination and associated factors among health workers. CadSaúde Pública [Internet]. 2019 [cited Aug 26, 2019];35(4):e00169618. doi: http://dx.doi.org/10.1590/0102-311x00169618

20. Heimann C, Prado C, Moraes RRSP, Vidal GV, Liberal D, Oliveira GKS, et al. Acquiring nursing knowledge through the constructivist method. Rev Esc Enferm USP. [Internet]. 2013 Aug [cited Aug 26, 2019];47(4):997-1000. doi: http://dx.doi.org/10.1590/1982-019420130000400032

21. Sousa ATO, Formiga NS, Oliveira SHS, Costa MML, Soares MJGO. Using the theory of meaningful learning in nursing education. Rev Bras Enferm. [Internet]. 2015 Aug [cited Aug 26, 2019];68(4):713-22. doi: http://dx.doi.org/10.1590/0034-7167.2015680420i

22. Miranda RPR, Chaves CL, Lima RS, Braga CG, Simões IAR, Fava SMCL. The effectiveness of a simulated scenario to teach nursing students how to perform a bed bath: a randomized clinical trial. Nurse Educ Today. [Internet]. 2017 Oct [cited Feb 22, 2018];57:17-23. doi: http://dx.doi.org/10.1016/j.nedt.2017.06.008

23. Leigh GT. High-fidelity patient simulation and nursing students self-efficacy: a review of the literature. Int J Nurs Educ Scholarsh. 2008 Sep [cited Feb 22, 2018];5(1):1-16. doi: http://dx.doi.org/10.2202/1548-923X.1613

24. Akhu-Zaheya LM, Gharaibeh MK, Alostaz ZM. Effectiveness of simulation on knowledge acquisition, knowledge retention, and self-efficacy of nursing students in Jordan. Clin Simul Nurs. [Internet]. 2013 Sep [cited Feb 22, 2018];9(9):335-42. doi: http://dx.doi.org/10.1016/j.ecns.2012.05.001
25. Merriman CD, Stayt LC, Ricketts B. Comparing the effectiveness of clinical simulation versus didactic methods to teach undergraduate adult nursing students to recognize and assess the deteriorating patient. Clin Simul Nurs. [Internet]. 2014 Mar [cited Feb 22, 2018];10(3):e119-27. doi: http://dx.doi.org/10.1016/j.ecns.2013.09.004

26. Jarvill M, Jenkins S, Akman O, Kim SA, Pohl C, Peggy J. Effect of simulation on Nursing students’ medication administration competence. Clin Simul Nurs. [Internet]. 2017 Jan [cited Feb 22, 2018];1(1):1-5. doi: http://dx.doi.org/10.1016/j.ecns.2017.08.001

27. Martins JCA, Mazzo A, Baptista RCN, Coutinho VRD, Godoy S, Mendes IAC, et al. The simulated clinical experience in nursing education: a historical review. Acta Paul Enferm. [Internet]. 2012 Apr 13 [cited Feb 22, 2018];25(4):619-25. doi: http://dx.doi.org/10.1590/S0103-2100.2012000400022

28. Fabri RP, Mazzo A, Martins JCA, Fonseca AS, Pedersoli CE, Miranda FBS, et al. Development of a theoretical-practical script for clinical simulation. Rev Esc Enferm USP. [Internet]. 2015 Mar [cited Feb 22, 2018];29(1):87-96. doi: http://dx.doi.org/10.1016/j.bpa.2015.01.002

29. Kolb M, Grande B, Spahn DR. Briefing and debriefing during simulation-based training and beyond: content, structure, attitude and setting. Best Pract Res Clin Anaesthesiol. [Internet]. 2015 Mar [cited Feb 22, 2018];29(1):3-12. doi: http://dx.doi.org/10.1016/j.bpa.2014.07.003

30. Gardner R. Introduction to debriefing. Semin Perinatol. [Internet]. 2013 Jun [cited Feb 22, 2018];37:166-74. doi: http://dx.doi.org/10.1053/j.semperi.2013.02.008

31. Martins JCA. Learning and development in simulated practice environments. Enferm Refer. [Internet]. 2017 Mar [cited Feb 22, 2018];29(12):26-33. doi: http://dx.doi.org/10.12707/RIV16074

32. Coutinho V, Martins JCA, Pereira F. Structured debriefing in Nursing simulation: students’ perceptions. Nurse Pract Educ. [Internet]. 2016 Mar [cited Feb 22, 2018];6(9):127-34. doi: https://doi.org/10.5430/jnep.v6n9p127

33. Green R, Bull R. Simulated community spaces and nurses’ practice preparedness: a thematic inquiry. Clin Simul Nurs. [Internet]. 2014 Mar [cited Feb 22, 2018];10(3):111-7. doi: http://dx.doi.org/10.1016/j.ecns.2013.09.001

34. Costa RRO, Medeiros SM, Vitor AF, Lira ALBC, Martins JCA, Araújo MS. Types and purposes of the simulation in undergraduate nursing education: integrative literature review. Rev Baiana Enferm. [Internet]. 2016 Sep [cited Feb 22, 2018];30(3):1-11. doi: http://dx.doi.org/10.18471/rbe.v30i3.16589

35. Cavalcante C, Peres AM, Zagonel IPS, Amestoy SC, Meier MJ. Teaching-learning tendencies and strategies used in the leadership development of nurses. Rev Bras Enferm. [Internet]. 2018 Feb [cited Feb 22, 2018];71(Suppl 4):1531-9. doi: http://dx.doi.org/10.1590/0034-7167-2017-0455

36. Mcewan B, Hercelinisky G. An internal audit of a virtual learning space to facilitate clinical decision-making in nursing. Collect Essays Learn Teach. [Internet]. 2012 Apr [cited Feb 22, 2018];5:132-6. doi: https://doi.org/10.22329/celt.v5i0.3451

37. Botma Y. Nursing student’s perceptions on how immersive simulation promotes theory-practice integration. IJANS [Internet]. 2014 Apr 20 [cited Feb 22, 2018];1:1-5. doi: https://doi.org/10.1016/j.ijans.2014.04.001

38. Shapira-Lishchinsky O. Simulations in nursing practice: toward authentic leadership. J Nurs Manag. [Internet]. 2014 Jan [cited Feb 22, 2018];22(1):60-9. doi: https://doi.org/10.1111/j.jnms.2016.07.1365-2 834.2012.01426.x

39. Oliveira SN, Prado ML, Kempsf SS, Waterkemper R, Morera JAC, Bernardi MC. Learning through clinical experience simulation: perceptions in nursing students. Rev Iberoam Educ Invest Enferm. [Internet]. 2015 Jul [cited Feb 22, 2018];5(3):56-63. Available from: https://www.enfermeria21.com/revistas/aladef/e/article/173/learning-through-clinical-experience-simulation-perceptions-in-nursing-students/

40. Costa RRO, Medeiros SM, Martins JCA, Cossi MS, Araújo MS. Perception of undergraduate nursing students on realistic simulation. Rev Cuid. [Internet]. 2017 May 01 [cited Feb 22, 2018];8(3):1799-808. doi: http://dx.doi.org/10.1111/j.1365-2 834.2012.01426.x

41. Baptista RCN, Martins JCA, Pereira MFCR, Mazzo A. Students'satisfaction with simulated clinical experiences: validation of an assessment scale. Rev Latino-Am. Enferm. [Internet]. 2014 Oct [cited Feb 22, 2018];22(5):709-15. doi: https://doi.org/10.12707/RIV16074

42. Green R, Bull R. Simulated community spaces and nurses’ practice preparedness: a thematic inquiry. Clin Simul Nurs. [Internet]. 2014 Mar [cited Feb 22, 2018];10(3):111-7. doi: http://dx.doi.org/10.1016/j.ecns.2013.09.001

43. Martins JCA. Learning and development in simulated practice environments. Rev Enf Ref. [Internet]. 2017 Oct [cited Feb 22, 2018];4(12):155-161. doi: http://dx.doi.org/10.12707/ RIV16074
44. Herron EK, Nemeth J, Powers KA. Community health simulation with a standardized patient: exploring the experience. Clin Simul Nurs [Internet]. 2017 [cited Feb 22, 2018];13(7):331-7. doi: http://dx.doi.org/10.1016/j.ecns.2017.05.011

45. Costa RRO, Medeiros SM, Martins JCA, Dias VR. Perceptions of nursing students on the structural dimensions of clinical simulation. Sci Med. [Internet]. 2019 [cited Feb 22, 2018];29(1):e32972. doi: https://doi.org/10.15448/1980-6108.2019.1.32972