COMPETÊNCIAS NÃO-INSTRUMENTAIS NO ENSINO DE ESTUDANTES DE ENFERMAGEM: EFICÁCIA DE UM PROGRAMA EM CONTEXTO DE SIMULAÇÃO DE ALTA-FIDELIDADE

Non-technical skills in nursing education: effectiveness of a high-fidelity simulation-based course

SARA PIRES
Doutoranda, Mestre. Departamento de Educação e Psicologia da Universidade de Aveiro. Portugal

sarapires23@ua.pt

SARA MONTEIRO
Professora Auxiliar Convidada, Doutor. Departamento de Educação e Psicologia da Universidade de Aveiro. Portugal

ANABELA PEREIRA
Professora Associada com Agregação, Doutor. Departamento de Educação e Psicologia da Universidade de Aveiro. Portugal

JOANA STOCKER
Professora Auxiliar, Doutor. College of Natural and Health Sciences of Zayed University. Dubai

DANIELA CHALÓ
Professora Ajunta Convidada, Mestre. Escola Superior de Saúde da Universidade de Aveiro. Portugal

ELSA MELO
Professora Adjunta, Doutor. Escola Superior de Saúde da Universidade de Aveiro. Portugal

Abstract

Literature refers that patients are commonly affected by preventable adverse events associated with non-technical skills failures. Non-technical skills training programs address to prepare for, respond to, and mitigate adverse events in healthcare.

This study took place at Center for Clinical Simulation of Aveiro University. Third year prelicensure nursing students were included in two groups: control group (N=27), and experimental group (N=20, who participated in the training course developed, focusing on non-technical skills and crisis resource management acting principles). The study was divided in two different moments, before the implementation of the course, and after the implementation of the course. The course was then divided in three sessions: one four-hour theoretical session; and two three-hour practical sessions, each including two high-fidelity simulation-based different scenarios, four in total.

Regarding non-technical skills, we found significant differences in the experimental group in eleven items after intervention. As per participants' self-confidence levels, those who participated seem to have significantly increased confidence in their skills. Regarding social-demographic variables, it seems that students from primary healthcare tend to present better non-technical skills than students from maternal health specialty.

Overall these results seem to suggest that the course developed was effective in increasing students' knowledge and awareness on non-technical skills. It was demonstrated that the development and application of the structured course is feasible and positive changes in behavior can be measured through the instruments developed. Then, consideration must be given in integrating non-technical skills training into nursing education.

KEYWORDS: NON-TECHNICAL SKILLS; CRISIS RESOURCE MANAGEMENT; HIGH-FIDELITY SIMULATION-BASED TRAINING; HEALTHCARE; NURSING EDUCATION; NURSING STUDENTS.

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INTRODUCTION

Non-technical skills (NTS) such as communication, leadership, mutual support, situation-awareness, and decision-making are crucial to ensure patient safety, especially when managing crises[1]. Medical errors are common in crisis situations and the majority is due to NTS failures[2-5]. Therefore, understanding what NTS are, their relevance for healthcare and importance to patient outcomes is increasingly being recognized.

Indeed, crisis resource management (CRM) is a set of direct acting principles that encompass NTS, that were adapted from aviation industry to healthcare context, providing a simulation-based model for teaching and improving these skills within healthcare professionals and reduce errors[6-7]. CRM principles include: know the environment, anticipate and plan, call for help early, exercise leadership and followership, distribute the workload, mobilize all available resources, communicate effectively, use all available information, prevent and manage fixation errors, cross (double) check, use cognitive aids, re-evaluate repeatedly, use good teamwork, allocate attention wisely and set priorities dynamically[8].

Literature states that learners need to actively practice so that learning is effective[1]. Following this directive, in order to effectively provide NTS training, high-fidelity simulation has been shown to be an effective tool to teach CRM acting principles as it offers a safe environment for trainees to develop, practice and refine their knowledge and skills with no risk of harm to real patients[9]. High-fidelity simulation includes a realistic child or adult mannequins and monitors placed in a realistic clinical environment. Monitors and mannequins interface with a computer program to project and display vital signs, voice and, sometimes, movements. These mannequins mimic diverse parameters of human physiology (cardiovascular, pulmonary, metabolic, and neurological systems). Such programs that use high-fidelity simulation-based training proved to also improve participants' self-efficacy and confidence[10]. In fact, literature refers to several studies that emphasized NTS' improvement and successful clinical performance after its training courses[11-24]. Therefore, the development of NTS training programs in healthcare learning environments may significantly improve students' performance and self-confidence, and can be an added value as it can help them to adjust to the complex clinical context[22-23].

However, even though recent literature has highlighted the necessity of introducing NTS training and assessment within healthcare professionals[10;13;17;19;20;21;22;24] there is still little focus on a coherent and systematic integration of these skills into healthcare learning settings, such as nursing education[15;25;26].

OBJECTIVE

Therefore, the main purpose of this study was to develop and examine the efficacy of a high-fidelity simulation-based course focusing on NTS and CRM acting principles for undergraduate nursing students in order to promote its knowledge and usage as well as increase confidence on their clinical performance, with the ultimate objective of improving patient care and safety and contribute to error reduction in their future practice.

METHOD

The present study took place at Center for Clinical Simulation of Aveiro University, in the School of Health of Aveiro University and the Scientific Committee granted respective approval.

In order to recruit participants all 3rd year prelicensure nursing students were invited to participate in the study and were informed of the purpose of the study, nature of their involvement, and potential benefits and risks in participating. Then, a written informed consent was obtained from those who volunteered to participate. Confidentiality was guaranteed in that data would be reported as group data only. Students were also informed that taking part in the study was entirely voluntary and had no impact on their curricular evaluations. It should be noted that it was not possible to randomize the sample as there were students who volunteered only to answer the questionnaires and be included on control group.

Forty-seven students volunteered to participate in the study: twenty-seven students in the control group, and twenty students in the experimental group. The control group attended the usual classes. The experimental group attended the usual classes and participated as well in the high-fidelity simulation-based training course, focusing on NTS and CRM principles, developed for this study.

The study was divided in two moments, before the implementation of the course to the experimental group (phase 0), and after the implementation of the course to the experimental group (phase 1). There was a drop-out of fifteen participants from the control group (experimental group remained the same), being that only thirty-two participants completed the study and were included in the analyses (control group = 12; experimental group = 20). The drop-out was due to the fact that these students were not present in

all sessions where questionnaires were administered, as the sessions occurred in usual classes. Participants' ages ranged between 20 (68.2%) and 39 years old (Mean=21.34; Standard Deviation=3.75), primarily female (85.1%). All participants were at the 3rd year of undergraduate in nursing, and had no experience in high-fidelity simulation, and knowledge or experience on NTS or CRM principles. The last experience on an internship was in 2nd year. The specialties experienced were 63.8% in primary health, 34% in maternal health, and 2.2% in cardiology.

To evaluate the course four instruments were constructed: a sociodemographic questionnaire (age, gender, class, year, experience in high-fidelity simulation, knowledge and experience with NTS, knowledge and experience on CRM principles, and specialty of the last internship accomplished); the Non-Technical Skills Assessment Scale in Nursing (NTSN); a self-confidence questionnaire; and a satisfaction questionnaire.

The NTSN was used to evaluate students' NTS performance in nursing activities and consists of a unidimensional scale, constituted by a list of 63 items with a five-point Likert scale: "totally disagree", "partially disagree", "neither agree nor disagree", "partially agree", and "totally agree", and a "non-applicable" option. For its construction and development, all norms were followed, namely, analysis of items for construct representativeness, its comprehensibility and suitability to nursing students' competences, and application context. It was reviewed by three nursing experts, besides the study researchers, and then tested in a group of six senior nursing students. In relation with the scale psychometric qualities, most items present a significant and positive relationship. Cronbach alpha presented a good value .94, and exploratory factor analysis with one factor explained 26% of the variance.

The self-confidence questionnaire was used to evaluate participants' confidence in their performance, with four items using a five-point Likert scale: "not at all confident", "little confident", "confident", "very confident"; "extremely confident", and a "non-applicable" option.

Lastly, the satisfaction questionnaire was used to evaluate the experimental group satisfaction with the course in general and its contents in particular, with 17 items using a four-point Likert scale: "insufficient", "sufficient", "good", "very good", and a "non-applicable" option. The questionnaire was divided in four evaluation areas: structure and content, instructor, resources and teaching materials, and global appreciation.

The Non-Technical Skills Nursing Course (NTSNC) was designed and developed based on NTS and CRM principles and acting strategies and some already developed programs, such as the Neonatal Intensive Care Multidisciplinary Crisis Resource Training program[27]; the Simulated Trauma and Resuscitative Team Training course[28]; and the TeamSTEPPS training curriculum developed by the United States Department of Defense and the Agency for Healthcare Research and Quality. The NTSNC learning objectives aimed to provide an overview on the course objectives (general and learning session´s objectives); define a team and its members responsibilities and roles; define NTS concept and understand its importance in healthcare, more precisely in nursing practice; describe NTS such as communication, leadership, mutual support, situation-awareness, and decision-making; define CRM as a structured strategy for improving NTS and describe its principles, adapted for undergraduate nursing students; and finally, apply NTS and CRM principles to clinical scenarios in high-fidelity simulation environment.

The course was divided in three sessions: one four-hour theoretical session; and two three-hour practical sessions, each including two high-fidelity simulation-based different scenarios, four in total. The theoretical lecturer introduced the NTS and CRM principles and acting strategies. The practical sessions took place in high-fidelity simulation environment, where an initial and general orientation to the simulation equipment (mannequins and monitors) was conducted. In this context, students had the opportunity to briefly interact with the human patient simulator and learn its capabilities (and limitations). To assure that the practical sessions would be more effective, the experimental group was divided in two smaller groups of ten students each and then these students were divided in active (Sample=5) and observer participants (Sample=5). Active participants managed the first simulated crisis scenario while observers viewed the scenario via live video transmission and then participants changed position for the second scenario, different from the first one. Practical session's contents and the four high-fidelity simulation scenarios were the same for both groups. Each high-fidelity simulation scenario was introduced and initiated with a briefing by giving students information about the clinical case scenario and instructing them to proceed as a nursing team. During each scenario students should manage a crisis that would arise regarding not only technical skills but essentially NTS. Scenarios lasted approximately 15 minutes and were immediately followed by a focused and structured debriefing discussion, for 45 minutes. Debriefing was conducted in a different room with all participants and an expert instructor, using videos of the scenarios, to promote reflective practice on NTS and CRM principles and acting strategies and identify strengths and weaknesses areas for their future performance improvement. At the end of the theoretical and each

high-fidelity simulation scenario debriefing on practical sessions, a satisfaction questionnaire was administrated.

All participants (control and experimental groups) answered the sociodemographic questionnaire, the NTSN, and the self-confidence questionnaire: before, immediately and six months after the course implementation to the experimental group. Besides these, the experimental group also answered the satisfaction questionnaire five times: after the theoretical session, and after each high-fidelity simulation scenario.

Differences on control group and experimental group were analyzed to evaluate progression on students' NTS performance in nursing activities in general, as well as their self-confidence levels. With this purpose, results from NTSN and self-confidence questionnaire were compared in each group (control and experimental) and between groups and phases. Social-demographic variables were also used to perform further differential studies within the sample (results from phase 0 were used to control intervention related variables). Finally, satisfaction levels with the course developed for the experimental group were also explored in order to understand what sessions contributed the most to students' NTS improvement (phase 1). SPSS was used to run paired and independent samples T-test, as well as Analysis of Variance (ANOVA) and lastly Analysis of Repeated Measures to compare all three phases.

RESULTS

Considering the NTS, we found no significant differences in total scale results. This suggests that overall there is no difference between control and experimental group for the total score obtained in the NTSN nor across phases 0 and 1 within each group (before and after the intervention).

However, when performing the same analyses for each NTSN items from phase 0 to phase 1, we found significant differences in the experimental group in 11 items (**Table 1**).

The means increased in the majority of the 11 items, such as in item 6 ("I know all team members' names"), 7 ("I know patients' names"), 8 ("I know who's the patients' relatives"), 14 ("I contribute to the clear definition of the strategy and intervention plan"), 31 ("I acknowledge to the team my own limitations"), 35 ("I use a technical language when communicating with the team"), and 51 ("I am receptive to other team members' opinions even when they are different from mine"), except for items 9 ("Mobilize all available resources to resort patients' information"), 17 ("Proceed to the proper hand hygiene before intervening"), 33 ("Always address people directly by name"), and 43 ("Always confirm medication before its preparation and administration").

In the control group we also found significant differences in four items from phase 0 to phase 1 (**Table 2**). However, contrary to the experimental group, except in item 31, the means decreased in the majority of items, such as item 12 ("I have prior access to information/history and current situation of the patient"), 21 ("Leader knows how to communicate with the team"), and 62 ("I am focused on the patient during care").

As per participants' self-confidence levels, there were no significant differences across groups (control and experimental) in both phases 0 and 1, nor between phase 0 and phase 1 in the control group. Nonetheless, we found significant differences between phase 0 and phase 1 in the experimental group. More specifically, students who participated in the NTSNC seem to have significantly increased confidence in their skills (Significance=.025), as the overall mean was higher after the implementation of the course.

Regarding social-demographic variables, we found no significant differences in NTSN total scale for gender nor for internship specialty. Although there were also no differences between males and females in ›

TABLE 1

DIFFERENCES ON NTSN* ITEMS IN THE EXPERIMENTAL GROUP. AVEIRO, PORTUGAL, 2017

Item	Phase 0			Phase 1			Paired Samples T-test		
	N†	Mean	SD‡	N†	Mean	SD‡	t§	df‖	p¶
6	20	4.15	.933	20	4.85	.489	-3.390	19	.003
7	20	4.00	.858	20	4.75	.550	-3.943	19	.001
8	20	2.90	.788	20	4.15	1.424	-3.206	19	.005
9	20	4.40	.754	20	3.65	.587	3.470	19	.003
14	20	3.50	.513	20	4.20	.410	-4.765	19	.000
17	20	4.25	.851	20	3.60	1.046	2.668	19	.015
31	20	3.50	.688	20	4.20	.696	2.896	19	.009
33	20	4.25	.639	20	3.90	.308	2.666	19	.015
35	20	4.30	.733	20	4.85	.366	-3.240	19	.004
43	20	4.40	.681	20	3.90	1.021	2.364	19	.029
51	20	4.45	.686	20	4.80	.410	-2.666	19	.015

*NTSN – Non-Technical Skills Assessment Scale in Nursing.
†N – Sample.
‡SD – Standard deviation.
§t – Student's t-test value.
‖df – Degrees of freedom.
¶p – Significance value.

TABLE 2

DIFFERENCES ON NTSN* ITEMS RESULTS ON CONTROL GROUP. AVEIRO, PORTUGAL, 2017

Item	Phase 0			Phase 1			Paired Samples T-test		
	N†	Mean	SD‡	N†	Mean	SD‡	t§	df‖	p¶
12	12	4.75	1.288	12	3.75	1.288	2.253	11	.046
21	12	4.42	.900	12	3.83	.577	2.244	11	.046
33	12	3.17	.835	12	4.00	.603	-3.079	11	.010
62	12	4.83	.389	12	4.17	.718	2.966	11	.013

*NTSN – Non-Technical Skills Assessment Scale in Nursing.
†N – Sample.
‡SD – Standard deviation.
§t – Student's t-test value.
‖df – Degrees of freedom.
¶p – Significance value.

TABLE 3

DIFFERENCES IN NTSN* ITEMS BETWEEN PRIMARY HEALTHCARE MATERNAL HEALTH IN PHASE 0. AVEIRO, PORTUGAL, 2017

Item	Primary health care			Maternal Health			Independent samples T-test		
	N†	Mean	SD‡	N†	Mean	SD‡	t§	df‖	p¶
1	30	4.63	.556	16	4.19	.655	2.434	44	.019
6	30	4.60	.675	16	3.44	.964	4.295	23	.000
12	30	4.93	1.172	16	3.88	.806	3.600	41	.001
14	30	3.70	.702	16	3.19	.655	2.411	44	.020
15	30	3.67	.758	16	3.19	.655	2.136	44	.038
26	30	4.27	.828	16	3.38	1.025	2.998	26	.006
27	30	4.33	.802	16	3.44	1.094	3.173	44	.003
29	30	4.20	.761	16	3.56	1.153	2.254	44	.029
50	30	5.13	1.042	16	4.31	.793	2.750	44	.009
52	30	1.73	1.258	16	3.19	2.344	-2.310	20	.032
61	30	4.57	.504	16	4.88	.342	-2.456	41	.018
63	30	4.53	.629	16	4.50	.516	2.315	44	.025

*NTSN – Non-Technical Skills Assessment Scale in Nursing.
†N – Sample.
‡SD – Standard deviation.
§t – Student's t-test value.
‖df – Degrees of freedom.
¶p – Significance value.

all NTSN items, there were 12 items that presented significant differences between two specialties: primary healthcare and maternal health. Curiously, NTSN means are always higher in primary healthcare rather than in maternal health, except for item 52 ("I was involved in situations of conflict with other team members"). This is because it is a negative item (refers to conflicts involvement) while all the other items are formulated in a positive way. Therefore, it suggests that the lower the mean, the less they were involved in conflictual situations (**Table 3**).

To evaluate participants' satisfaction with the course in general and its contents in particular (structure and content, instructor, resources and teaching materials, and global appreciation), differences on the satisfaction questionnaire results were performed. We found significant differences between theoretical and practical sessions 1 and 2 in the structure and content area (**Table 4**).

DISCUSSION

Based on the results previously presented we can assume that the experimental group revealed better results in comparison with the control group between phase 0 and 1. Although no statistically significant differences were found in general NTSN scores, maybe explained by the fact that students did not want to compromise themselves with disagreement scale options, answering instead towards what is expected them to know and behave (social desirability), when we analyzed the activities and skills described by each item, we found statistically significant and positive differences between phases 0 and 1 for the experimental group. This means that these students increased their knowledge reflected in their performance in NTS in some activities, contrary to the control group. Besides NTSN unidimensionality, and even though all items integrate and measure the same construct, they do not have to do with each other in the sense that each item refer to a different context and/or activity. For example, item 2 "I know the equipment / clinical material that is available" and item 19 "The team leader is clearly established" measure the same construct – NTS, but refer to a specific activity and are not correlated. Therefore, we can conclude that there is a positive progression in experimental group students' perception on their knowledge and then performance in NTS after the course sessions developed and implemented in this research. This seem to reinforce other researches' results, such as The Simulated Trauma and Resuscitative Team Training curricula which is

TABLE 4

DIFFERENCES ON SATISFACTION QUESTIONNAIRE RESULTS. AVEIRO, PORTUGAL, 2017

	Theoretical session			Practical session 1			Practical session 2			ANOVA*		
	N†	Mean	SD‡	N†	Mean	SD‡	N†	Mean	SD‡	F§	df‖	p¶
Structure**	20	3.66	.247	20	3.90	.126	20	3.89	.190	9.5	2	.000
Instructor	20	3.87	.256	20	3.88	.224	20	3.94	.111	.714	2	.494
Resources††	20	3.70	.410	20	3.83	.373	20	3.83	.335	.745	2	.480
Global	20	3.83	.296	20	3.88	.311	20	3.93	.232	.629	2	.537

*ANOVA – Analysis of variance.
†N – Sample.
‡SD – Standard deviation.
§F – test F for variance analysis.
‖df – Degrees of freedom.
¶p – Significance value.
**Structure – Structure and content.
††Resources – Resources and teaching materials.
‡‡Global – Global appreciation.

also associated with improvement in team CRM skills over the duration of the course[28].

Nonetheless, some items presented a decrease on their means in the experimental group which can be explained by the fact that students were able to develop higher levels of awareness of what NTS are and of their performance on them. As so, this can be considered a somehow positive result, as students informally shared with the researchers that they've overestimated their responses in phase 0, as they did not have the full knowledge and experience on NTS or CRM principles and acting strategies.

In relation to control group results, the fact that they've demonstrated a positive progression in item 31 ("I acknowledge to the team my own limitations") can be due to a greater requirement for clinical skills as they are at the end of their academic career and are more aware of their capabilities and limitations at the technical level. Besides, this item also demonstrated progression in the experimental group. Finally, the fact that the academic nursing curricula doesn't include NTS training, might make it more difficult for students to feel confident and secure on their performances.

In fact, this study demonstrated that this type of training can contribute not only for a better understanding and then performance on NTS, which contribute to students' improvement on technical skills, but also to increase their self-confidence. More specifically, students who participated in the NTSNC seem to have significantly increased confidence in their skills, as demonstrated by literature. This situation will, in its turn, necessarily promote and improve the quality of care provided and decrease errors in their future practice.

Curiously, NTSN means are always higher in primary healthcare rather than in maternal health. As so, it seems that students from primary healthcare tend to present better NTS than students from maternal health specialty, especially those related to their involvement on teams' decisions and encouragement. This result shows that internships are different depending on teams' sensibility in NTS.

Finally, students from the experimental group showed greater satisfaction with the structure and content of the course in the practical sessions compared with the theoretical one. In this sense, students seem to appreciate more the practical sessions instead of theoretical session in the course structure and content. These results may be due to the fact that the practical sessions are more appealing and interesting as the students can put the acquired knowledge in the theoretical session into practice.

Therefore, these results show that high-fidelity simulation is well received by those experiencing it and offers benefits not inherent in traditional nursing education modalities, in the way that simulation-based methodologies emphasize both technical and NTS that are fundamental to a new paradigm of currently evolving education[29]. To further reinforce this focus, such programs should be incorporated in undergraduate nursing curricula from the first year in order to enable students to become familiar with the concept of NTS, CRM, and high-fidelity simulation-based training as well, to afford the opportunity to continuously practice these skills in a safe environment and to become more competent and, consequently, confident in their skills[10]. In this sense, even though the results of the interaction of the three phases didn't demonstrate significant differences between both groups and intergroup, one thing we can conclude and evaluate, when asked what are NTS or CRM principles, only the experimental group answered correctly. This means that they are aware and have the knowledge to put in practice, contrary to the control group, that

cannot improve their performance on something that did not know or learned of.

In a time where increased effort is focused on improving the quality of healthcare delivered, while minimizing adverse events, a methodology that allows teams to learn and practice critical teamwork and communication skills in a safe environment is invaluable[30].

Recognizing that a lack of NTS can produce lethal consequences and there are still limited studies related to its training in undergraduate nursing students, consideration must be recommended that this training be integrated into nursing education[10] as it is essential for undergraduate nursing students to develop not only clinical but also NTS. NTS training can enhance healthcare professionals understanding of their roles and improve communication. The majority of healthcare curriculums emphasize technical skills and forget that NTS remain an important component for rapid responsive teams on emergency settings for example. These components reflect team cohesion and team collaboration[31].

One of the limitations of our study was the size of the sample. Future studies should be tested with a bigger sample. In this sense, it was difficult to overcome this difficulty, as students do not have the experience and knowledge on the topic, and do not consider NTS as important as technical skills. It is also important to refer that the dropped out of those 15 participants, was due to the fact that they were not present at the session where they were asked to complete the questionnaires. These sessions were scheduled on normal school days, and the motive that led them to give up had nothing to do with the study because students were not informed of the classes where the questionnaires would be administered.

CONCLUSION

Overall, experimental group showed significant improvements in NTS nursing activities and the course was well received by them. In general terms, the results demonstrated that students who participated in NTSNC were able to focus and improve the outlined NTS necessary to complement their clinical and technical skills.

As NTS continues to increase its importance in educational settings, there is a need to ensure that this topic is explicitly embedded in undergraduate nursing education.

In this study, it was demonstrated that the development and application of a structured high-fidelity simulation-based course on NTS, is feasible and that positive changes in behavior can be measured through the instruments developed. In this sense, more studies are necessary to conduct in order to consolidate and improve these results.

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