Original Article

Effects of a Simulation Education Program on Faculty Members' and Students' Learning Outcomes

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Abstract

Background: Successful high-fidelity simulation requires adequate knowledge and skills in educators.
Aim: This study aimed to assess the effectiveness of a simulation education program on learning outcomes of nursing faculty members and students.
Methods: This quasi-experimental a single group, pre-post-test study design was carried out with 30 faculty members and 249 sophomore nursing students. The study consisted of two sections: the first section was the implementation of the simulation education program with faculty and the second section was the implementation of high-fidelity simulation with students by faculty members in their institutions. Data were collected three times by using instruments for both faculty members and students.
Results: The simulation education program increased faculty members' knowledge and self-assessment scores. Also, there was an increase in students' knowledge scores after the high-fidelity simulation, and students indicated high satisfaction and self-confidence levels.
Conclusion: The simulation education program was found to be effective in improving the learning outcomes of faculty members and students.
Keywords: simulation education program, faculty learning outcomes, high fidelity simulation, student learning outcomes.
Key Words: simulation education , faculty members, students, learning outcomes

Introduction

To develop competent nurses, educators are responsible for preparing nursing students for complex clinical practice environments and developing student-centered active learning methods. High-fidelity simulation (HFS) is a technology-based teaching and learning modality (Ayed and Khalaf, 2018) that provides nursing students with several learning opportunities that are unavailable in the clinical settings in a safe environment (Arthur, Levett-Jones, & Kable, 2013).

HFS, which appeals to the learning habits of younger generations who have grown up with technology, has several positive learning outcomes. Many studies have demonstrated that faculty members and nursing students were satisfied with simulation teaching strategies (Ayed and Khalaf, 2018; Howard, Englert, Kameg, & Perozzi, 2011). Furthermore, HFS has been shown to increase nursing students' self-confidence (Alamrani, Alammar, Alqahtani & Salem, 2018; Ayed and Khalaf, 2018; Tawalbeh, 2017), knowledge, skills (Glidewell & Conley, 2014; Yuan, Williams, Fang, & Ye, 2012), and self-efficacy (Kimhi et al., 2016; Lee, Lee, Lee, & Bae, 2016) and to improve the development of critical thinking (Alamrani et al, 2018), clinical judgment (Ayed and Khalaf, 2018) and problem-solving skills (Lee et al., 2016). In addition, a study conducted by the National Council of State Boards of Nursing showed that 50% of clinical practice could be replaced with quality simulation under appropriate conditions (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014).

Educators are indispensable in a simulation-based learning experience, and they take an important role in facilitating and evaluating HFS. To achieve successful learning outcomes of such simulations, the quality of the learning experience is important, which is closely associated with the competence of the educator. When the educator is inexperienced, the simulation-based experience can be at risk. Educators should know how to use simulation teaching strategies in nursing education (Hallmark, 2015). Therefore, the International Nursing Association for Clinical Simulation and Learning (INACSL) has published best practice standards for simulations and determined the standards of the educator as one of these. (Boese et al., 2013). In the most current revised version of the standards, the content of the educator-related standard was integrated into the facilitation and participant integrity standards (INACSL Standards Committee, 2016). According to these standards, educators have a crucial role in simulation-based learning; they should take continuous training regarding simulation and work with seasoned facilitators. Additionally, educators should possess the necessary skills to manage all types of complicated simulation-related situations, support students in accomplishing learning outcomes via scenarios, and guide and encourage students in establishing evidence-based solutions and developing decision-making skills (Boese et al., 2013, INACSL Standards Committee, 2016).

HFS, which has been used as an educational strategy in nursing education in other countries for several years, is a relatively new concept in Turkey. The number of Turkish schools investing in HFS has increased recently.

Although simulation centers have been founded and space has been dedicated for simulators, education for simulation facilitators is often ignored not only in Turkey but also around the world. There is only training for the simulator given by the employees of the mannequin vendors; however, in Turkey there is no formal training that exists for nursing faculty. It is important that educators possess sufficient knowledge and skills regarding simulation to ensure successful implementation. A few studies have measured the outcomes of simulation education programs around the world (Roh, Kim, Tangkawanich, 2016, King, Moseley, Hindenlang, & Kuritz, 2008). It is timely to develop and determine the effectiveness of a simulation education program (SEP). This study aimed to evaluate the effectiveness of a SEP on outcomes in faculty members and nursing students.

Methods

Aim: The objective of this study was to assess the effectiveness of a SEP on the outcomes of faculty members and nursing students.

Design: This study was a quasi-experimental a single group pre-post-test study.

Research questions

The study questions were as follows:

(a) Is the nursing SEP effective in improving the knowledge and self-assessment scores of faculty members?

(b) Is the SEP effective in improving the knowledge about hypovolemic shock, the satisfaction levels, and the self-confidence scores of nursing students?

Participants and sample size: The sample of the study consisted of faculty members and second-year nursing students. All faculty members from universities that possessed high-fidelity adult simulators and offered a bachelor's degree program in Turkey were invited to participate in the study. Thirty faculty members who willing to use simulation as a teaching modality participated in the SEP. The eligibility criteria for students was being in their second-year and having never participated in HFS about hypovolemic shock.

The reason to use second-year students was due to the fact that hypovolemic shock is in the second-year curriculum according to National Core Education Program in Nursing in Turkey (HUCEP, 2013). Three hundred volunteer sophomore students were included in the sample. However, of the 30 faculty members in the study, 27 had performed HFS with second-year students during the spring semester. Faculty members who performed HFS reported that 11 students did not attend the simulation sessions; therefore, data for 249 students were analyzed. This study consisted of two sections: the first section was the implementation of the SEP with faculty, and the second section was the implementation of HFS with students by the faculty members in their institutions.

Development of the Intervention

Content of the SEP: Prior to the planning of the SEP, the educational needs of faculty members were assessed in order to tailor the SEP according to their needs by using the Educational Needs Questionnaire. This questionnaire was developed by the researchers based on INACSL standards. The questionnaire was emailed to faculty members, and they were asked to complete the form, as the content of the SEP could be altered according to educational needs. The data were analyzed, and the results showed that faculty members needed all the listed subjects.

Simulation Education Program (SEP): The aim of the SEP was to improve faculty members' ability in planning, implementation, and evaluation of a simulation and writing a scenario. The content of the SEP was prepared based on INACSL standards (INACSL Standards Committee, 2016). The needs assessment of the faculty was taken into account during the preparation of the SEP. The duration, aim, and learning objectives of the SEP were determined by the researchers. The SEP was implemented for three days: theoretical education was provided for two days, and a simulation scenario involving a patient in hypovolemic shock was implemented with the faculty on the third day of the SEP. In addition to the development of the SEP, the researchers developed a simulation scenario involving a patient with hypovolemic shock resulting from postoperative bleeding, based on the literature (Alinier, 2011), to use in the SEP for faculty and the HFS for students. The scenario was finalized based on the opinions of five simulation experts. Also, the scenario was tested in the simulation laboratory with a group of second-year students before using. The same scenario was used on the SEP day for faculty members and the HFS for students to ensure that faculty members were familiar with the HFS.

Data Collection: The SEP was implemented at a university in Turkey between February 10 and 12, 2016. Data were collected three times: before the SEP, after the SEP, and after the HFS with the students by using instruments for the faculty members and the students.

Instruments

Instruments for faculty members: To collect data from the faculty members, instruments with two sections were used. The first section consisted of a knowledge test regarding simulation that included sociodemographic characteristics data, and the second section was a self-assessment questionnaire.

Knowledge test for faculty members: The researchers developed a knowledge test based on the literature (INACSL Standards Committee, 2016; Zigmont et al., 2015; Jeffries, 2013) to evaluate faculty members' knowledge regarding simulation before and after the SEP. The knowledge test included 25 multiple-choice questions, with two points awarded for each correct response. The highest possible score was 50. The content validity of the questions was tested by five simulation expert educators, and necessary changes were implemented based on their opinions. The instrument was also tested on faculty members who were not planning to participate in the study in order to determine face validity and question clarity. Four questions were revised after this process. Content validity index (CVI) was 0.91 and the Cronbach's alpha value was 0.84.

Self-assessment questionnaire for faculty members: The researchers developed an HFS-related self-assessment questionnaire for faculty members based on the literature (Lioce et al., 2015; Zigmont and et al, 2015; Jeffries, 2013). The questionnaire included 11 items pertaining to all HFS processes, each with two response options. It also included a Visual Analog Scale (VAS) ranging from 0 to 10 to evaluate faculty members' perceptions of their simulation-based knowledge and skills. The questionnaire was presented to the five simulation expert educators and minor changes were implemented. Content validity index was 0.90 and the Cronbach's alpha value was 0.73.

Instruments for students: There were two data collection instruments for students: a knowledge test regarding hypovolemic shock (that also included sociodemographic characteristics [age, sex, and grade point average]) and the Student Satisfaction and Self-Confidence in Learning Scale (SCLS).

Knowledge test regarding hypovolemic shock for students: The researchers developed a knowledge test based on the literature (Lewis et al., 2017) to evaluate students' knowledge regarding hypovolemic shock before and after the HFS. The questionnaire included ten multiple-choice questions, with five points awarded for each correct response. The highest possible score was 50. The content validity of the questions was tested by five educators in the area of surgical nursing, and necessary changes were made. The instrument was also tested with second-year students who were not planning to participate in the study in order to determine face validity and question clarity. Two questions were revised after this process. Content validity index was 0.90, and the Cronbach's alpha value was 0.63.

Student Satisfaction and Self-Confidence in Learning Scale: The Turkish version of the Student Satisfaction and Self-Confidence in Learning Scale (SCLS), which was adapted by Karaçay and Kaya, was used in the study. The Cronbach's alpha coefficient was 0.90. In addition, the Cronbach's alpha was 0.89 for the satisfaction subscale and 0.83 for the self-confidence subscale. Scores were calculated by summing responses (Karaçay& Kaya, 2017).

Ethical Considerations: Before the implementation of the study, ethical approval was obtained from the ethics committee of Koç University (2015. 130.IRB3.063). In addition, written permission was obtained from the schools where the simulation training was performed and from all participants.

Intervention: The SEP was implemented for three days.

Theoretical days of the SEP: Faculty members completed the knowledge test, which included sociodemographic characteristics data, and the self-assessment questionnaire prior to the SEP. The researchers presented all the theoretical topics over two days. Active educational teaching and learning techniques such as role-play, group work, brainstorming, question-answer, and video were used during the educational sessions. The second day of education included a lecture on scenario writing, after which faculty members formed three groups in order to write scenarios on their chosen topics and present them on the third day of education. The scenarios were discussed and finalized by the researchers during the SEP day.

Practice day of the SEP: The simulation laboratory was introduced to the faculty member and their questions were answered. Faculty members familiarized themselves with the equipment, simulator, roles, and environment, and the simulation was conducted. A debriefing session was done by using a constructive debriefing method after the simulation. At the end of the SEP, faculty members completed the knowledge test and self-assessment questionnaire and provided an information sheet on the steps in the simulation for students in order to be used during HFS with their students. They also received a certificate of attendance to the SEP.

HFS with students: Faculty members implemented the hypovolemic shock scenario via the HFS for second-year students at their institutions during the spring term. Thus, they had the opportunity to apply their knowledge and experience acquired from the SEP into practice. Faculty members selected participants from a pool of volunteer second-year students. Students completed the knowledge test on hypovolemic shock before the HFS. Faculty members performed the HFS with two groups of five students at their institutions. Following the simulation, the students completed the knowledge test and the SCLS. In addition, faculty members completed the self-assessment questionnaire following the HFS.

Data Analysis: The Statistical Package for the Social Sciences version 22.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The normal distribution of the variables was assessed by using the Shapiro-Wilk test. Descriptive statistics were used to describe the participants' characteristics. Other data analysis was performed by using the Friedman test, the Mann-Whitney U test, paired-samples t test, and Cochran's Q test. Statistical significance was established using a two-tailed alpha of 0.05.

Results

Of the faculty members included in the study, 93.3% were women. The mean age of faculty members was 30.7 (SD = 4.8, range: 23–41) years. In addition, 56.7% of faculty members considered their technological skills good, and 66.7% had not received any simulation training. Of those who had received training, 70% received 16 hours of training from mannequin vendors and from educators outside their institutions. Moreover, 66.7% of faculty members did not use HFS in their courses, and the mean duration of utilization of simulation was 2.1 (SD = 1.6) years.

Table 1 Faculty members' VAS skill levels before and after SEP and after HFS with students

	Skill level		
	M	*SD*	*Mdn*
Before SEP (n = 30)	3.25	2.26	2.50
After SEP (n = 30)	6.47	1.96	7.00
After HFS with Students (n = 27)	7.27	1.21	7.60

Note. Friedman test results (levels indicated using a visual analog scale); Skill: χ^2 = 30.30, p = .001; HFS = high-fidelity simulation; *Mdn* = median; *M* = mean; *SD* = standard deviation; SEP = simulation education program

Table 2 Comparison of faculty members' self-assessments before and after SEP and after HFS with students

Self-assessment questions	Before SEP (n = 30)		After SEP (n = 30)		After HFS with Students (n = 27)		*Q*	*p*
	n	%	*n*	%	*n*	%		
Simulation planning								
I can plan every step of a simulation.	5	16.7	21	70.0	25	92.6	29.55	.001
I can write a scenario tailored to the level of students.	4	13.3	23	76.7	20	74.1	26.27	.001
I can manage the pre-briefing session.	10	33.3	27	90.0	26	96.3	34.30	.001
I can create as realistic a situation as possible in simulations.	7	23.3	26	86.7	23	85.2	31.18	.001
Simulation implementation								
I can support/encourage students throughout the simulation.	19	63.3	28	93.3	26	96.3	18.18	.001
During the simulation, I can use the technology efficiently and make changes to the simulator easily.	6	20.0	9	30.0	17	63.0	13.73	.001
Simulation evaluation								
I can hold a mirror up to the students effectively during debriefing.	8	26.7	21	70.0	23	85.2	19.05	.001
I can ask students good "what if…" questions that will enable them to think critically.	8	26.7	22	73.3	24	88.9	25.52	.001

I can reveal the strengths and weaknesses of the students to improve them.	17	56.7	28	93.3	25	92.6	17.29	.001
I can review scenarios after simulations and correct missing parts in subsequent applications.	16	53.3	26	86.7	24	88.9	15.86	.001
I can develop a good evaluation plan for the simulation.	8	26.7	15	50.0	19	70.4	14.80	.001

Note. HFS = high-fidelity simulation; SEP = simulation education program

Research Question 1: Faculty members' mean knowledge scores increased significantly, from 34.47 (*SD* = 5.48, *Mdn* = 34) before the SEP to 45.53 (*SD* = 2.61, *Mdn* = 46) after the SEP ($z = 4.713$, $p < .01$). In addition, their VAS knowledge and skill scores increased significantly after SEP ($p = .001$) and simulation with students ($p < .01$). However, when faculty members' VAS knowledge and skill scores after SEP and after simulation with students were compared, the difference was not statistically significant ($p > .05$; Table 1).

There was a significant difference between the faculty members' pre-SEP, post-SEP, and post-HFS self-assessment scores for simulation planning, implementation, and evaluation ($p < .01$; Table 2).

Research Question 2: Of the students included in the study, 82.7% were women. The mean age of students was 20.5 (*SD* = 1.2; range: 18–28) years, and their mean grade point average was 2.87 (*SD* = 0.42). Students' mean knowledge scores increased from 36.59 (*SD* = 7.78, range: 15–50) before HFS to 40.64 (*SD* = 6.30, range: 20–50) after HFS, $t(248) = -9.835$, $p = .001$). Their knowledge scores also increased significantly following the simulation ($p < .01$). Students' mean post-HFS scores for the satisfaction and self-confidence in learning SCLS subdimensions were 22.68 (*SD* = 2.83; range: 6–25) and 33.62 (*SD* = 4.17; range: 10–40), respectively, and their mean overall SCLS score was 56.31 (*SD* = 6.55; range: 16–65).

Discussion

A lack of training for educators is one of the factors that complicates the use of mannequin-based simulations (Jansen, Johnson, Larson, Berry, & Brenner, 2009; King et al, 2008). The literature suggests that most simulation educators do not receive formal training regarding simulation strategies (Hallmark, 2015; Kardong-Edgren, Willhaus, Bennett, & Hayden, 2012). For example, Kardong et al. (2012) showed that most simulation educators receive training from the employees of mannequin vendors, who lacked pedagogical information regarding simulation teaching strategies; in addition, simulation was performed by educators who had not received adequate training, and training for educators was often overlooked (Kardong-Edgren et al., 2012). In the current study, most faculty members had not received training in simulation strategies before, and some faculty with some training had received only 16 hours of training, with eight hours of training provided by the employees of mannequin vendors. In addition, the faculty members included in the study had used the strategy for two years on average. These results suggest that HFS is a relatively new concept in Turkey, and simulator selection and location during the establishment of laboratories were prioritized in Turkey, as in other countries. However, training for educators, who play a critical role in the success of HFS, was not considered a priority and necessary resources for their training were not allocated, and the training received by the educators was insufficient to plan each step of the simulation. It may result in the scarce use of simulation in nursing education. Similarly, in the current study, only one-third of faculty members from institutions with simulators in their simulation laboratories used simulation as a teaching strategy.

In the study, faculty members' knowledge of simulation teaching strategies increased following the SEP. Therefore, the use of active learning and teaching methods during SEP, allowing faculty members to perform HFS in simulation laboratory and answering faculty members' questions could be considered effective means of accomplishing this result. Similarly, since faculty members are adult learners and they were motivated to use simulation in their institution, the increases in their perceived knowledge and skill scores following the SEP were also predictable results. After the SEP, the faculty members performed the simulation with the students, and they had the opportunity to apply knowledge into practice. Due to insignificant changes between pre-SEP and post-HFS scores, it was thought that the knowledge and skills obtained from the SEP could have been used for the HFS with their students. Similarly, faculty members' self-assessed ability of planning, implementation, and evaluation of simulation increased post-SEP and post-HFS with students in the study. If educators are incapable of planning a simulation from start to finish, this could prevent the accomplishment of learning objectives via simulation. In the current study, most faculty members stated that they considered their technological skills good, but only 20% stated that they could alter the simulator easily prior to SEP. This finding was similar to those of Jansen et al.'s (2009) study, which showed that faculty members experienced difficulty in using simulation technology and required training in simulation use. Through the education program and post-HFS, most of the faculty members gained experienced in technology use and simulator programming.

Although there is no study which evaluated the students' outcomes of the SEP, the literature indicates that HFS increases students' knowledge (Glidewell & Conley, 2014; Yuan et al., 2012), satisfaction with simulation (Ayed and Khalaf, 2018; Howard et al., 2011) and self-confidence (Ayed and Khalaf, 2018). Similarly, in the current study, students' knowledge scores and self-confidence scores increased following the HFS, and they were satisfied with the HFS. These findings could have been related to the enthusiasm of faculty members (despite the fact that it was their first simulation experience); the use of the same scenario during the SEP and the HFS with the students; proceeding step-by-step according to the checklist; the provision of a student guide to prepare students for the simulation; and the appropriate management of debriefing sessions.

However, a limitation of this study should be noted: as there were no instruments to measure faculty members' improvement related to the simulation, their skills were measured based only on self-assessment.

Conclusions: The SEP was found to be effective in improving the learning outcomes of both faculty members and students. Most faculty members used HFS for the first time in the study even though they worked at institutions with simulators. The study has contributed to the proper implementation of simulation teaching and learning modality and the effective use of simulators existing in nursing schools. The results showed that SEPs should be given regularly by competent educators to increase nursing faculty' skills and knowledge concerning simulation. As a result, the SEP can be used as a model in international countries, especially those where a simulation is a new teaching strategy. It is recommended that future research focus on developing instruments to measure and follow faculty members' skills and improvement.

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