Medium and High Fidelity Simulations in Training Undergraduate Nursing and Operating Room Students. Are They Effective?

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Abstract

Background: Simulators-Based Education is any type of educational activity that uses simulation of clinical scenarios to increase students' awareness and skills. Simulation environments are able to create a place for students to expand their competencies in specialized skills without posing a risk to patients. In simulation, an attempt is made to bring the learning conditions so close to the real conditions, so that the learned concepts can be transferred to the real world.

Methods: This is a quasi-experimental study. The statistical populations of the study were nursing and operating room (OR) students of Larestan University of Medical Sciences who were selected using census method. A total of 192 students participated in this study, which 96 students were in the control group and 96 students were in the experimental group. At the beginning of the study, students of both groups participated in the pre-test. In this study low-fidelity simulation was used to train control group, and in the experimental group training, medium- and high-fidelity simulation were applied. The post-test was performed after completion of the training program of both groups. 4 instruments were used for data collection. The data were analyzed using SPSS software (version 20.0).

Results: The results of this study showed that students in the experimental group scored significantly higher in knowledge domain compare to control group students, and also performed better in the objective structured clinical examination (OSCE) ($P<0.001$). Also, this study showed that the average total score of students' attitudes towards the role of simulators in the experimental group is higher than the control group. Statistical relationship was significant in some factors such as "patients' safety ($P= 0.014$)", "increasing the student's self-confidence ($P= 0.041$)", "connecting the topics taught in the theoretical units ($P= 0.024$)". Also, statistical relationship was meaningful in training with low-fidelity models which stated "it was not a reliable learning experience ($P= 0.004$)".

Conclusions: Simulation is an effective method for better teaching-learning that can increase knowledge, improve clinical competence, feel more confident and integrate knowledge in a safe and controlled environment.

Background

Nursing education comprises pragmatic curricula that manifest both theoretical knowledge and applied skills. In skill-oriented learning strategies, where learning through practice plays a major role, ensuring the integration of theoretical knowledge into practice is of vital importance (1). The basic perspective of high quality nursing education programs elaborates the basic discipline of global standards (2). However, traditional teaching methods, in which the nursing education faculty facilitate training in a teacher-centered approach, and the transmission of information solely relies on a one-way communication techniques, are no longer sufficient and efficient to meet the needs of the rapidly changing society (3). Such educational systems mainly lead to teaching methods in which students are not the focus, and as a result, it nurtures students who play a passive role in nursing practice. For this reason, curricula in nursing

education need to be reformed in such a sense that provides students opportunities to take on a more active role. This requires application of more innovative approaches in the education system (4). In this context, simulations, advocated by so many scholars, provide an innovative teaching method. Simulation-Based Medical Education is any type of educational activity that uses the simulation of clinical scenarios to increase students' awareness and skills in workplace (5). In other words, simulation is a method that can be designed to reflect real-life conditions. By definition simulation replicates events and the related cases similar to the standards of a clinical environment (6). Simulation allows students to practice and learn their clinical skills and competence in a safe and anxiety-free environment. Normally it occurs with ease and without fear of making mistakes, until students are empowered with the sufficient skills, which will lead to better development of critical thinking and clinical decision-making skills. Additionally, simulation provides an educational method that encourages active learning to develop skills through repetition of events based on real-world scenarios (7). The World Health Organization (WHO) highly recommends the use of innovative methods such as simulation in nursing school education programs (2). Nursing practices are performed in complex and dynamic health settings; therefore, to succeed in their role in these environments it is essential that nurses be always exposed to well-designed educational experiences (8).

Basically there are five types of simulations applied in nursing education which are outlined in the following. Low-tech or static task trainer: This type of simulator does not respond to students and includes simple tools such as skin for stitching training. Complex task trainer simulation: Similar to CPR mannequin that has a sensor; in this type of simulator student receive feedbacks. Simulated patient: Refers to the role played by a classmate or other person in the patient's role. Screen-Based Computer Simulator: Is a process performed on a computer which is designed to predict the behavior of or the outcome of a real-world or physical system. It simulates a specific task or environment and also gives feedback to the student. Integrated Simulation: A combination of advanced computer technology and complete or partial body mannequins. One key point in applying simulators in educational training is the level of accuracy, also known as the level of realism. In terms of functionality, simulators are divided into three categories: low, medium/moderate, and high fidelity. Low-fidelity simulators are used to demonstrate skills and, in some cases, they are applied to enhance students’ skills and practice. Simulations of medium-fidelity are used to teach more complex skills and are closer to reality, such as mimicking heart and lung sounds. In high-fidelity simulations healthcare education methodology involves the use of sophisticated life-like mannequins in realistic patient environments. More importantly, students receive physiological responses in high-fidelity simulations (9). A number of researches have been done to study simulators effects on different variables such as learning, knowledge level, clinical skills, self-confidence, etc. using quantitative or qualitative schemes and or a combination of both. Kapucu (2017) ascertained that simulation-based education prepares nursing students for real clinical environments (10). Kim (2017) stated that critical thinking and clinical judgment were important and necessary characteristics of nurses to perform their professional tasks. Nursing students can develop clinical judgment skills and evaluate scenarios with the guidance of an instructor in a simulated training (11). Lin (2016) found that learning by simulation methods increases students' self-efficacy levels in relation to

basic nursing skills (12). Lubbers and Rossman (2016) found that nursing students were very satisfied with the simulation experience (13). In their study Mohammed and Ahmed (2016), determined that simulation training increased satisfaction, self-confidence, and higher nursing skills (14). In his research, Bussard (2015) indicated that using simulation in nursing education increased patient safety and improved inter-professional expertise (15). Lindsey and Jenkins (2013) determined that nursing students who has received clinical simulation training intervention showed a higher level of clinical knowledge and judgment (16). Cordeau (2012) stated in her research that through simulated training, nursing students enhanced their self-confidence by performing appropriate nursing care and were promoted from a novice nursing student to a professional nurse (17). Wilson (2012) stated that simulation methods help nursing students gain more effective communication skills and critical thinking (18).

Nonetheless there are some education boards and faculty that claim instructors can teach all nursing skills without the need for sophisticated skill labs, and are content with simple mannequins in nursing training. Hence this study, conducted in Larestan University of Medical Sciences, underlines the role and concept of medium- and high-fidelity simulations, to shape nursing and OR undergraduate students' perspectives and clinical competence.

Methods

Study design and participants

The present quasi-experimental study was conducted during May-July 2020 at Larestan University of Medical Sciences. The research goals were investigating the effects of medium- and high-fidelity simulations in preparing Undergraduate Nursing and operating room (OR) students for clinical activities. In this regard, students' knowledge, skills and attitudes were evaluated.

Sampling: The statistical populations of the study were nursing and OR students of Larestan University of Medical Sciences who were selected using census method. Inclusion criteria included passing the theory lesson of nursing principles and skills for nursing students and passing the theory lesson of principles and techniques of clinical skills for OR students, and of course willingness to participate in the study. For each field, students enrolled in two specific academic year were consider as control group and students enrolled on other two academic year were consider as experimental group. A total of 192 students participated in this study, which 96 students were in the control group and 96 students were in the experimental group.

Data Collection instruments: 4 instruments were used for data collection.

Demographic information form which included student's personal profile such as gender and age, field and year of entry to university. A questionnaire containing 27 questions to assess students' attitude, which is based on the Likert scale, and there are five options for each question: strongly agree, agree, undecided, disagree, strongly disagree; that a score of 1 to 5 is awarded to them. For the validity and reliability of this questionnaire: first the English questionnaire was translated into Persian by 2 English

language experts. Then the Persian version was translated into English by 2 other person and the original English questionnaire was matched with the questionnaire translated from the Persian version to confirm the accuracy of the translation. It was also culturally adapted. Then, the validity of the questionnaire was confirmed by five experts. The English questionnaire was provided to us by McCaughey Caroline S., the author of the article “The role of simulation in nurse education” (19). Student Knowledge Assessment Questionnaire, which consisted of 20 four-choice questions, which were assigned one point to the correct answer and zero point to wrong answer or no answer. Check list of objective structured clinical examination (OSCE) stations to assess students’ skills, which included 5 stations. Station No 1. (Peripheral intravenous cannulation), Station No 2. (Nasogastric tube insertion), Station No 3. (Urinary catheter insertion), Station No 4. (Endotracheal intubation), Station No 5. (Cardiopulmonary resuscitation). The test score ranged from zero to 128. Finally, the score obtained from the knowledge assessment questionnaire was added to the score obtained from the OSCE and then the score was calculated based on 20.

Procedure

For each field, students enrolled in two specific academic year were consider as control group and students enrolled on other two academic year were consider as experimental group. A total of 192 students participated in this study, which 96 students were in the control group and 96 students were in the experimental group. The students were verbally informed of the purpose, context, and method of the research. Because of the special circumstances due to the prevalence of Corona virus (Covid-19), all the points of health protocols and physical distancing also were explained to the students. Written informed consent was obtained from the participants. The participants were assured that the information they provide to the research will be used only for the purpose of this research and their privacy will be protected. At the beginning of the study, students of both groups participated in the pre-test by implementing health protocols and physical distancing. In this way, first the demographic information forms were filled in by students and then the attitude questionnaires were given to them. After that, knowledge assessment questionnaires were given to students. Then, an OSCE was held to assess students’ skill, which included 5 stations. Before entering the test site, students rested in a separate hall, and after explaining how to hold the test, 5 students were selected in each turn and each student entered a room (a station). After the specified time has elapsed, they left the station with the sound of the alarm clock and went to the next station in a clockwise direction, so that each student passed 5 stations and then they left the test site. Training started the day after the pre-test. In such a way that the students of both control and experimental groups were divided into smaller groups and two sessions were held every week for each small group lasting 2 hour, which trainings were conducted by several instructors in separate rooms and finally the total training lasted 8 weeks. In the control group, teaching the clinical skills of nursing and OR was done traditionally by presenting a lecture, Power Point presentation and using low-fidelity mannequins that had no the capability for providing feedback. In the experimental group, in addition to lectures and Power Point presentations, clinical skills training for nursing and OR student’s was conducted at the clinical skills center and by using medium- and high-fidelity mannequins and models that had the capability for providing feedback.

The clinical skills center, which was recently opened in Larestan University of Medical Sciences, consists of 12 rooms and has units of nursing, midwifery, operating room, anesthesia, medical emergencies, physical exam, conference room, practice room and locker room. Mannequins and models in the nursing unit: Advanced nursing mannequin, child nursing mannequin, blood pressure manual training model, nasal feeding training model, NG TUBE tracheostomy training model, bed wound care training model, female catheterized training model, arm model for veins extraction, Enema training model, surgical dressing torso model, arm for training IM and SQ injections, forearm model for intra-skin injections, pad for teaching cannulation, injection training pad (two veins), DC shock. Models in the emergency medical and anesthesia unit: ALS adult MEGA CODE mannequin with VITAL SIM, CPR child training mannequin with QCPR device, CPR adult training mannequin with intubation and shock capability, CHEST TUBE training model, choking training model, Top and lower body models for bandage training, seat belt, safety necklace, backpack, suction training model, 25 kg injured transport and rescue mannequin. Models in the OR and anesthesia unit: Adult intubation model with laryngeal spasm and suction capability, child intubation model, spinal injection training model, baby head model for vein training, arm model for suturing training, suture practice kit, Anesthesia machines, various kinds of surgical instruments. Models in the midwifery unit: maternal and neonatal simulation with cyanosis and CPR capability, Leopold maneuvering mannequin, measuring engagement of the fetal head model, cervical effacement and dilatation measurement training model, episiotomy training model, Ob/Gyn training model, family planning training model, IUD placement training model, child nursing mannequin (male and female), infant model for intubation and CPR with the umbilical catheter, delivery instrument set and episiotomy set, Doppler fetal monitor. In this center, clinical skills training for experimental group was done according to the purpose of the study and by using the relevant mannequins and models. Then students of the experimental group practiced on these mannequins and models. The practice method was such that while performing the technique by each member of the group, the other members evaluated her/his technique and discussed about it after completing and presented the necessary feedback to each other. Instructor monitored the students' performance at all stages and provided them with the necessary feedback. The book Clinical Skills Center, written and published by the first author of this article, was given to the students of the experimental group, in which purpose of establishing the clinical skills center, center's mannequins and models and how to work with them are explained. Throughout the study, necessary health protocols and physical distancing were fully observed and both groups passed the post-test after completing the trainings. The pre-test and post-test conditions were the same in different ways for students of both groups.

Statistical analysis

SPSS version 20 statistical software was used for data analysis. Mean and standard deviation were used to describe quantitative variables; Frequency and frequency percentage were used to describe qualitative variables. Independent t-test was used to compare the mean score of knowledge, attitude and skills between the two groups of intervention and control, as well as gender and field of study, and paired t-test was used to compare the mean score of knowledge, attitude and skills before and after the intervention. Chi-square test was also used to compare gender distribution, age group and field of study between the

two groups. One-way analysis of variance was also used to compare the mean score of attitude between age groups. P < 0.05 was considered statistically significant.

Ethical considerations

The present study was approved by the Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran (code: IR.SUMS.REC.1399.740). The students were verbally informed of the purpose, context, and method of the research. Because of the special circumstances due to the prevalence of Corona virus (Covid-19), all the points of health protocols and physical distancing also were explained to the students. Written informed consent was obtained from the participants. The participants were assured that the information they provide to the research will be used only for the purpose of this research and their privacy will be protected.

Results

The results showed that 64.6% of the students in the control group were male and 35.4% were female and in the experimental group 45.8% were male and 54.2% were female. There was a significant difference between the control and experimental groups concerning their gender (P = 0.009). Most of the students participating in the control and experimental group were 18–22 years old, so that 62.5% in the control group and 86.5% in the experimental group were 18–22 years old. There was also a significant difference between the two groups concerning the participants' age (P = 0.002). Out of a total of 96 students in the control group, 73 students (0.76%) were studying nursing and 24% were studying OR, while in experimental group 72.9% of students were studying nursing and 27.1% were studying OR. There was no significant difference between the two groups of experimental and control in terms of their field of study (P = 0.619).

Comparison of the mean grade point average obtained in the domains of knowledge and skills of students in the control and experimental groups, before and after the intervention, showed that a statistically significant difference between the two groups (P < 0.001). The results of Table 1 showed that students in the experimental group scored significantly higher in knowledge domain compare to control group students, and also performed better in the OSCE (Table 1).

Table 1
Comparison of the mean grade point average obtained in the domains of knowledge and skills of students in the control and experimental groups, before and after the intervention

Group	Prior intervention		After invention		Mean difference		P-Value
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
Control	13.84	1.35	13.08	1.28	4.32	0.52	0.393
Experimental	13.76	1.16	18.08	1.04	0.045	0.58	□0.001
P- value	0.655		□0.001		□0.001		

Considering that the range of scores assigned to each attitude question varies from 1 to 5, so the minimum score of each person in the control and experimental group is 27 and maximum score will be 135; therefore, the average score of the answer to each question was used to report the score of each question (Table 2).

Table 2
Comparison of students' attitude in the two groups towards the roll of simulator in student's preparation, after the intervention

row	Group / Variable	Control Group		Experimental Group		Total		P-Value
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
1	A helpful educational experience for managing a patient's treatment	4.31	0.825	4.35	0.711	4.33	0.768	0.991
2	Enhancing patient safety	3.86	0.913	4.17	0.854	4.02	0.895	0.014
3	Better decision making in a clinical setting	3.84	1.040	3.71	1.085	3.78	1.062	0.366
4	The learning experience was unreliable	3.46	1.132	2.99	1.091	3.22	1.133	0.004
5	More responsibility	3.96	0.807	3.94	0.892	3.95	0.848	0.955
6	Efficient to develop from nursing student to nursing staff	3.55	0.983	3.47	1.142	3.51	1.063	0.824
7	Getting the organizational skill of a registered nurse	3.61	0.899	3.63	1.069	3.62	0.985	0.910
8	More certainty in clinical diagnoses	3.49	1.036	3.61	1.146	3.55	1.091	0.358
9	Competence to assess a patient's condition	3.69	0.921	3.59	1.236	3.64	1.088	0.840
10	Schedule patient care more efficiently	3.66	0.961	3.61	1.173	3.64	1.070	0.933
11	Increase the ability to provide comprehensive care	3.95	0.851	3.99	1.010	3.97	0.932	0.479
12	Evaluation of prior care provided to the patient	3.75	0.846	3.85	0.995	3.80	0.922	0.305

row	Group Variable	Control Group		Experimental Group		Total		P-Value
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
13	Boost confidence in dealing with the actual patients	3.70	1.027	3.97	1.031	3.83	1.035	0.041
14	Increasing students' esteem as a member of the treatment team	3.72	0.855	3.75	1.005	3.73	0.931	0.577
15	More worries about the future job	3	1.161	3.14	1.253	3.07	1.207	0.527
16	Training was not realistic based on clinical conditions	3.33	1.063	3.55	1.104	3.44	1.086	0.183
17	Helped the student find the connection between the topics learnt in the theoretical units	3.67	0.970	3.97	0.945	3.82	0.967	0.024
18	Learning from mistakes	3.84	0.910	3.98	1.086	3.91	1.001	0.122
19	Useful training for working in clinic	3.89	0.893	4.05	1.019	3.97	0.959	0.077
20	It had no effect on clinical diagnoses	3.03	1.147	2.88	1.117	2.95	1.132	0.290
21	Identify areas that need to be strengthened in practice	3.61	1.009	3.77	1.061	3.69	1.036	0.250
22	Improving communication skills	3.46	1.178	3.44	1.195	3.45	1.183	0.919
23	Increasing the range of skills required by a nursing student	3.72	1.023	3.71	1.169	3.71	1.096	0.839
24	Effective in assessing the patient's condition	3.57	1.013	3.77	1.031	3.67	1.024	0.180
25	Compatibility with team skills	3.26	1.069	3.46	1.222	3.36	1.149	0.204

row	Group Variable	Control Group		Experimental Group		Total		P-Value
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
26	Made students anxious about changing from a nursing students to nursing staff	2.97	1.156	2.94	1.177	2.95	1.164	0.730
27	Positive impact on student confidence to act as a nurse.	3.66	1.065	3.77	1.183	3.71	1.124	0.303

The mean scores of students' attitudes towards the role of simulators before and after the intervention were not significantly different between the control and experimental groups. Findings of this study indicated that the average total score of students' attitude towards the role of simulators in the experimental group is higher than the control group; however, it is not statistically significant (Table 3).

Table 3
Comparison of students' attitudes in the two groups towards the role of simulators in students' preparation, before and after the intervention

Group	Prior intervention		After invention		Mean difference		P-Value
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
Control	97.43	11.36	97.56	13.69	0.13	12.22	0.943
Experimental	97.98	13.61	99.05	16.55	1.07	14.29	0.612
P- value	0.788		0.538		0.624		

The total means of the answers to the attitude questions towards the role of simulators in the students' preparation in two groups of male and female students were 97.12 ± 13.35 and 99.76 ± 17.11 respectively. The results of Table 4 indicated that there is no significant difference between the two groups of male and female students in terms of answering the attitude questions of simulators' role (P = 0.231) (Table 4).

Table 4
Comparison of students' attitude in the two groups towards the role of simulators in students' preparation, by gender

Gender	Mean	Standard deviation	P-Value
Male	97.1226	13.35501	0.231
Female	99.7674	17.11255	

Comparison of the total means of the answers given to the attitudes questions to the role of simulators for preparing students in age categories according to the Table 5 indicated that there is no significant difference between age categories in terms of answering attitude questions to the role of simulators (P = 0.05) (Table 5).

Table 5
Comparison of students' attitude in the two groups towards the role of simulators in students' preparation, by age

Age(year)	Mean	Standard deviation	P-Value
18–22	97.6853	15.97420	0.050
23–28	100.2791	11.35431	
29–34	91.8000	11.41052	
35 years and older	135.0000	0	
Total	98.3073	15.16935	

The total means of the answers given to the attitude questions towards the role of simulators for preparing students in the two groups of nursing and OR students were 95.86 ± 14.93 and 105.42 ± 13.63 respectively, the results of Table 6 indicated that there is a significant difference between nursing and OR students in terms of answering attitude questions to the role of simulators (P < 0.001). The results of table below show that OR students has had a significantly better attitude towards the role of simulators (Table 6).

Table 6
Comparison of students' attitude in the two groups towards the role of simulators in students' preparation, by field of study

Field	Mean	Standard deviation	P-Value
Nursing	95.8671	14.93990	0.000
OR	105.4286	13.63207	

Discussion

In the present study, the effect of simulators with intermediate- and high-fidelity was investigated in preparing undergraduate nursing and OR students for clinical work. The results of this study showed that students in the experimental group scored significantly higher in knowledge domain compare to control group students, and also performed better in the OSCE. Kim (2017) indicated in his study that students had a higher degree of academic success, skill and clinical competence in the educational method of simulation (11). Rode et al. (2016) showed in their research that students of intervention group who received nursing training with the method of simulation were significantly better in the knowledge domain

(knowledge retention) than students of control group who received their education through traditional teaching strategies (20). Edeer and Sarikaya (2015) have declared in their research that simulation is a preferred educational method for nursing students in acquiring knowledge, skills development and improving the clinical skills (6). Mohamed Soliman et al. (2014) indicated in their study that nursing students in the experimental group who were taught using the simulation method had higher scores in knowledge and skills' domain than the control group (21). Liaw et al. (2012) showed in their research that nursing students have improved their knowledge and performance in simulation method compare to other methods (22). The results of all these researchers are consistent with the results of this study.

In line with the purpose of study in attitude's domain, the findings of this study showed that the average total score of students' attitudes towards the role of simulators in the experimental group is higher than the control group, and convincingly states the effect of using these simulators as a valuable learning method that has had a positive effect on the clinical efficiency of nursing and OR students. The study found that training with advanced models, improved patients' safety, and students made less mistakes dealing with real patients. Ozkal and Cayir's findings (2016) nursing students stated that the simulation method, by providing life-like opportunities was effective to increase their practice skills. Participants also stated that the simulation method allowed them to gain invaluable experiences without harming patients and mastered new skills by learning from their mistakes (23). In line with Bussard (2015), Handwerker (2012) and Brady's findings (2011) simulators improved patients' safety (15, 24, 25). McCaughey et al. (2010) determined that high-fidelity simulation enable students to increase their skills associated with patients' safety (19). Hovancsek et al. (2009) believe that the most important reason for using the simulation method in nursing is preparing nurses for critical situations as well as patients' safety (26). The results of all these researchers are consistent with the results of this study. Since nursing students chiefly experience their clinical practice in a real environment, insufficient skills can incur sever physical and mental harm to patients. Therefore, to ensure patients' safety, it necessitates that nursing education methods be designed in a sense that students be able to acquire the adequate nursing skills in a life-like clinical environment (27, 28). In this regards simulated patient and mannequins can reduce anxiety and facilitate the students' skill acquisition. Simulations also, reduce students' errors and therefore, the likelihood of patients harm can significantly be reduced and can be used at all levels of nursing education (29–31). Concerning patients' safety, it is envisaged that simulations in nursing education be expanded even more in the coming years. Our results showed that students who trained with advanced models felt more confident with the same conditions they encountered as a novice in real clinical situations. Kaddoura et al. (2016) showed in their study that using high-fidelity simulation is effective in promoting critical thinking, self-confidence and student competence (32). All these researchers including Lucas (2014), Tosterud et al. (2013), Thidemann and Soderhamn (2013), Aebersold et al. (2013), Jeffries (2012), Oldenburg (2012) showed in their research that using simulators increased nursing students' self-confidence (33–38). Norman et al. (2012) maintained that self-confidence was an integral result of the simulation experience (39). McCaughey et al. (2010) also showed in their research that high-fidelity simulations in increase student's self-confidence (19). Simulations give student's opportunity to actively participate in learning process (30). The findings of all these researches are consistent with the findings

of this study. Students in this study also showed that using advanced models helped them to understand the correspondence between topics taught in theoretical units. Kaddoura et al. (2016) showed in their study that the use of high-fidelity simulation was effective in integrating theory and practice and knowledge recognition (32). Also, Oermann and Gaberson (2014), Yuan et al. (2014), Gates et al. (2012), Liaw et al. (2012), in their research determined that simulators led to integration of theory and practice, which improves the application of theory to practice with no risk in a safe environment (40–42, 22). Mould et al. (2011) showed positive feedback from nursing students, such as: learning through simulation is fun and valuable, and it helps them to grasp the connection between theory and practice (43). Kaddoura (2010) found that simulation contributed to link theory and practice. Simulations help students to relate what they learn in the class to what they encounter in the clinical or patient care environment (44). McCaughey et al. (2010) also showed in their research that high-fidelity simulators are useful for correlation between theoretical units and performance. 87% of students participated in McCaughey's study reported simulators contributed to understand the relationship between theoretical components of nursing curriculum (19). These findings also are in line to this study. In recent years, due to the profound gap between theoretical knowledge and clinical practice, we are witnessing nursing students in spite of the fact that they have acquired outstanding theoretical knowledge, are not able to efficiently apply their knowledge into practice in actual clinical environments (45–47). It is a worldwide fact that nursing quality services credits nursing science and profession. In this viewpoint it is necessary that medical schools provide opportunities to link theoretical knowledge and skilled competence so that nursing students can gain useful experiences. In other words nursing students need new educational methods that allow students to take on more active roles and receive appropriate feedbacks. Simulation, to fulfill such goals, provides an opportunity for the student to experience their clinical practice in a life-like environment and transmits theoretical knowledge into a variety of psychomotor skills. Simulation techniques in fact can act as a bridge between theoretical content and clinical practice, providing students with the opportunity to learn new skills under supervision without endangering themselves or others (48). In simulation, an attempt is made to bring the learning conditions so close to the real conditions in a way the learned concepts become transferable to the real world. There is a kind of cause-effect correlation between the qualitative-quantitative aspects of nursing training and clinical competence. In this view the more efficient the learning methods today, the more competence future nurses will be ensured for the health public. We found that students in the control group, having higher mean scores and a statistically significant relationship, showed that training with low-fidelity simulation was not a reliable learning experience. Baptista et al. (2016) recognized that nursing students think a high-fidelity simulation helped them to better evaluate the patient and make decisions, and that high-fidelity simulation was more realistic (49).

Finally, it is noteworthy to mention that it is not only students but faculty members need training to use the equipment and simulation experience. It is essential that faculty members be able to use technology and recognize the challenges in this area. Pazargadi et al. (2011) stated that knowledge and awareness of faculty members in various fields such as nursing, education, research, management and administration, foreign language and computer, affect their performance (27). In 2014, a prominent

national study by the NCSBN showed that nursing education programs could replace up to 50% of traditional clinical practice with simulation, provided that factors such as faculty members who have been formally trained in simulation, a sufficient number of faculty members to support students, experts who conduct theoretical thinking, and equipment to create a realistic environment be included in the project (50).

Application of research findings

It is hoped that the results of this study will be used in the planning of training courses for students in the fields of nursing, operating room, midwifery, medicine, etc., which are closely related to patients, as well as training of health and medical staff who have an important responsibility in providing high quality services.

Study limitations

One of the limitations of this study was the high cost of medium- and high-fidelity simulations. The study considered the situations only at one of the country's nursing schools, and more likely results may be different concerning other universities' conditions.

Conclusion

In implementation of training by simulation method, if medium- and high-fidelity mannequins and models are used and the necessary care is taken in designing scenarios, the results will be more effective. There are some challenges in using this method that can be resolved to a large extent with proper planning. Educational institutions can develop and expand simulation programs based on a general understanding of the technology and educational potential of this method. Despite the problems, the simulation training method by using advanced mannequins and models, has many advantages and can increase knowledge and improve clinical competence. It is also a unique and effective way to increase safety and security of patient, increasing the student' s sense of self-confidence, connecting the subjects taught in the theoretical units. Due to special emphasis that nursing knowledge has on ensuring patient safety and security, using this method in students' education in nursing schools seems necessary; and it should be included in the curriculum of nursing students with more emphasis so that we can contribute to the scientific development and consolidation of nursing knowledge and ultimately ensure health of the community by training more skilled and capable nurses.

List Of Abbreviations

WHO: World Health Organization

OR: Operating Room

OSCE: Objective Structured Clinical Examination

Declarations

Ethics approval and consent to participate

The present study was approved by the Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran (code: IR.SUMS.REC.1399.740). The participants were informed about the research goals and procedures. Also, the confidentiality of any disclosed information was guaranteed and voluntary participation was emphasized. Written informed consent was obtained from the participants. All methods were performed in accordance with the relevant guidelines and regulations.

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Authors' contributions

Farideh Yazdanpanah participated in the design of the study, acquisition, analysis, interpretation of data, manuscript drafting, and final approval of the version to be published. Leila Bazrafkan supervised the study and participated in the design of the study, analysis, and interpretation of data, and proofreading the manuscript. Azizallah Dehghan was involved in the design of the study, analysis, interpretation of data, and proofreading the manuscript. All authors have read and approved the final manuscript.

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Consent for publication

Not applicable

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available due to confidentiality of the identity of the participants. Data are however available from the authors upon reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

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