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Examining the effect of simulation-based learning on intravenous therapy administration' knowledge, performance, and clinical assessment skills of first-year nursing students

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ABSTRACT

Background: Most nurses at some point of, or throughout, their career will be involved in infusion care. Therefore, it is important to provide a realistic learning environment to nursing students regarding how to safely practice intravenous (IV) therapy administration.

Objectives: The aim of this study was examining the effect of simulation-based learning on IV therapy administration knowledge, performance and clinical assessment skills of first-year nursing students.

Methods: This study was a randomized controlled quasi-experimental study. A total of 62 students was included in the study. The students were randomly assigned to either hybrid simulation (HS) ($n = 31$) or low fidelity simulation (LFS) (n = 31) groups. In the HS group, each student performed in the standardized patients using moulage, and the LFS group each student was performed with mannequin using visuals. Each of the students' level of IV therapy administration knowledge, performance and clinical assessment and satisfaction and self-confidence score was evaluated.

Results: After the lecture, demonstration and simulation training, there was a statistically significant difference between groups in terms of knowledge ($p < 0.05$), IV catheter insertion performance in simulation and clinical ($p = 0.00$; p = 0.00) and clinical assessment to classify IV therapy complications on real patients (p = 0.00). Also, satisfaction and self-confidence scale scores of the students in the HS were significantly higher than in the LFS group ($p = 0.00$). However, there was no significant difference in simulation design scale scores between the two groups ($p = 0.164$).

Conclusion: The students in the HS group better transferred they had learned in the teaching environment to clinical practice. Also, the results show that creating an effective environment in simulation had a positive effect on the development of the students' clinical skills.

1. Introduction

Infusion therapy is administered in health-care settings, including hospitals, long-term care facilities, outpatient settings and patients' homes. Managing fluid, electrolyte, and acid–base imbalances often involve infusion therapy and the intravenous (IV) route is the most commonly used infusion therapy route (Kuş and Büyükyılmaz, 2020; Phillips and Gorski, 2014). However, there are risks, and some complications are serious and life threatening. IV therapy failures and IV therapy complications are also costly to the health care system (Helm et al., 2015). Most nurses at some point of, or throughout, their career will be involved in infusion care. Although education and practice of IV therapy administrations differ between countries, nurses are responsible for IV catheter insertion, administration of a wide variety of infusion solutions and medications, interventions aimed at prevention of complications (Gorski et al., 2017). Therefore, it is important to improve IV therapy management skills of students before graduation. While IV therapy administration is frequently performed in clinical settings, most students may have difficulty developing these clinical skills during clinical practice due to the high number of student and patient safety problems (De Souza-Junior et al., 2020). Nursing students should have exposure to develop these skills during their undergraduate programs in which various instructional methods and modalities (e.g., simulation) were used.

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Simulation-based education in nursing education provides students with an opportunity to develop skill proficiency in a safe, non-threatening environment (Basak et al., 2016; Gaberson et al., 2014; Sittner et al., 2013). There are various types of simulation methods used in nursing education. One of them is hybrid simulation (HS), which is defined by the International Nursing Association for Clinical Simulation and Learning (INACSL) as "*The use of two or more modalities of simulation to enhance the fidelity of a scenario by integrating the environment, physiology, emotions, and dialog of a real patient encounter*" (INACSL, 2016 p.43). The combination of a standardized patient (SPs) and a mannequin permits the practice of procedural skills. The concept was first reported by Kneebone et al. (2006) who described the blending of simulation modalities as 'patient-focused simulation' and is now widely used internationally. Studies shows that students who are trained with the combination of SPs and IV training arm/simulator have higher level of self-efficacy and better communication with patient and IV catheter insertion skills (Devenny et al., 2018; Jones et al., 2014; Takmak et al., 2021).

One of the most critical issues in simulation planning is to determine the level of fidelity depending on the objectives and level of learners. For example, visuals of equipment used in patient care can be used in low-level fidelity simulation (LFS) (Gore and Lioce, 2012). High fidelity simulation is designed to replicate clinical contexts with as much visual and functional precision as possible. The environmental conditions created for the scenario as well as moulage will influence participants' learning experience (Basak et al., 2016; Gore and Lioce, 2012).

Moulage is the art of creating visual and tactile cues for the learner for the purpose of increasing the realism of the simulation (Stokes-Parish et al., 2018). Moulage in simulation can be defined as "*The application of make up or other elements in order to add realism to simulation training by creating realistic looking*" (Foot et al., 2008). The use of moulage can give the appearance of slough, redness and swelling, which gives a clue to classified IV therapy complications. In addition, moulage allows learners and educators the opportunity to discuss clinical reasoning (Yılmaz and Sarı, 2018). To evaluate clinical assessment skills among healthcare students, moulage has been used in some healthcare degree programs. There is little known how to examine the efficacy of moulage in improving clinical assessment skills for IV therapy complications. However, moulage applications are effective in previous studies for enhancing clinical assessment skills for skin and wound (Garg et al., 2015; Goulart et al., 2012; Hernandez et al., 2013; Sabzwari et al., 2017; Seckman and Ahearn, 2010; Sezgunsay and Basak, 2020; Wang et al., 2015). The aim of this study is to examine the effect of simulation-based learning on IV therapy administration knowledge, performance and clinical assessment skills of first-year nursing students.

2. Methods

2.1. Research hypothesis

The hypothesis tested in this study was that the use of HS is more effective than the use of LFS in developing IV therapy management skills. Since SPs in HS have been used to teach and evaluate the clinical and communication skills of students, we expected that interaction with SPs would also increase students' self-confidence and satisfaction. In addition, we expected that using moulage in simulation would increase students' clinical assessment level.

2.2. Design and participants

A randomized quasi-experimental design was used in this study. The population of the study consisted of the 171 first year students enrolled in the Fundamentals of Nursing course during the spring term of the 2015–2016 academic years. The mean age of the students in the HS group was 18.54 ± 0.56 years, and in the LFS group, it was 18.80 ± 0.74 years. A large majority of the nursing students were female, and the students were in the same age group. No statistically significant difference was found between the groups in terms of age and gender ($t = -1.528$, $p = 0.132$) (Table 1).

Firstly, the students were completely informed about the study process; the volunteers were invited to participate in the study. No incentive was offered to the participants. In the power analysis performed prior to the research, effect size was found to be 31 students each group. Considering a drop-out rate of 10% total sample we wanted to reach 35 students for each group (Sakpal, 2010). Because of the number of students who want to participate in the research was 66, they were assigned 33 participants each group. The grades of the students were transferred to the Excel program and ranked from high to low grade level average. According to their success status, students in each group were grouped as high, medium and low average grade, and randomized by the simple random sampling using the lottery method. Four students were excluded from the study because they did not participate in evaluation of simulation performance. This study was completed with a total of 62 students, 31 from the HS group and 31 from the LFS group.

2.3. Instruments

Five faculty members who are specialists in the Fundamentals of Nursing evaluated the form and checklist in order to ensure the content validity before the interventions. The faculty members assigned suitability points to the test questions and checklist steps based on a four-point Likert scale (1: Not appropriate; 2: Slightly appropriate, revision required; 3: Fairly appropriate, minor changes required; 4: Highly appropriate). The necessary adjustments related to the specific context of the study were made depending on their recommendations.

2.3.1. Knowledge test for the IV therapy administration

The test was designed by the researchers according to the Infusion Nurses Society (INS) standards of practice (Gorski et al., 2017). The test comprised two separate tests as IV catheter insertion (10 multiple choice questions) and IV therapy complications (10 multiple choice questions). The highest score was 100, and the lowest score was 0. Students' knowledge scores were evaluated separately as IV catheter insertion and IV therapy complication.

2.3.2. Performance checklist for IV catheter insertion

The checklist for data collection was designed by the researcher according to the relevant references (Gorski et al., 2017; Potter et al., 2016). The same checklist was used in both groups. The IV catheter insertion performance checklist consisted of 25 steps, and each item was scored as "Performed = 0," "Partially performed = 1" or "Not performed = 2". The highest score was 50, and the lowest score was 0.

2.3.3. Performance assessment form for IV therapy complication

The form was prepared to determine performance of IV complication assessment in the laboratory and clinic by the students. The form

Table 1
Students' descriptive characteristics.

Descriptive characteristics	HS group (n = 31)		LFS group (n = 31)		t[a]	p
Age (Mean ± SD)	18.54 ± 0.56		18.80 ± 0.74		−1.528	0.132
	n	%	n	%	χ^2[b]	p
Gender						
Female	26	83.9	25	80.6	0.111	0.740
Male	5	16.1	6	19.4		
Total	31	100	31	100		

Abbreviations: SD, standard deviation; HS, hybrid simulation; LFS, low fidelity simulation.
[a] Independent-*t*-Test.
[b] Chi square test.

consisted two items for classifying of type and degree of the IV therapy complication. The students' answers were scored as correct classifying and incorrect classifying. When students answered correctly both the type and the degree of the complication, their assessing were received correct.

2.3.4. Students' satisfaction and self-confidence scale (SSSC)

The original scale was developed by Jeffries and Rizzolo (2006) and was adapted to Turkish as conducted by Unver et al. (2017). The scale is valid and reliable for Turkish society. The SSSC is a 13-item scale to measure student satisfaction with the simulation and self-confidence in learning. Unver et al. (2017) was found the Cronbach's alpha values as 0.85 for satisfaction, and 0.77 for self-confidence. The Cronbach's alpha

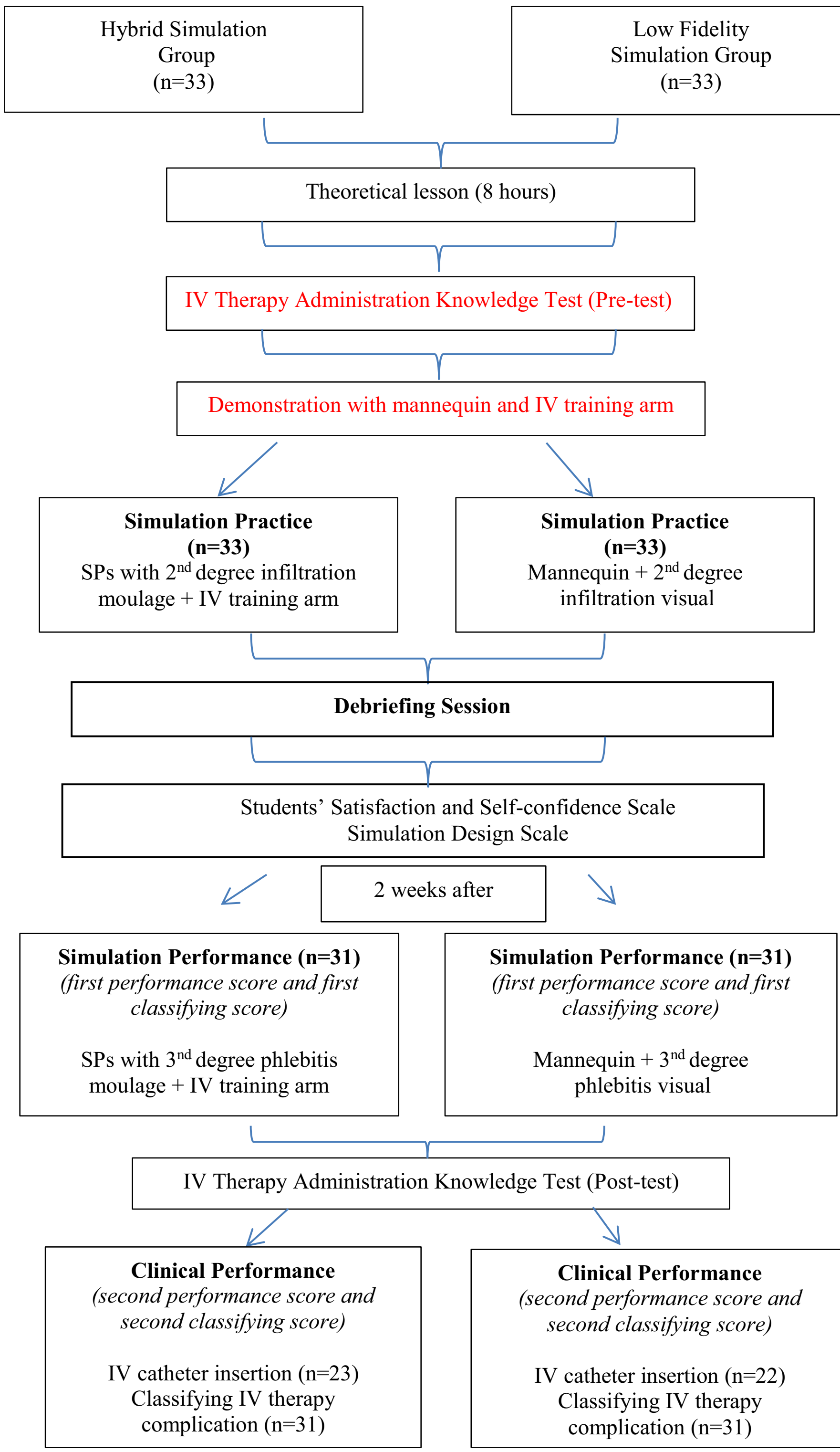

Fig. 1. The flow diagrams of the study.
Abbreviations: IV, intravenous; SPs, standardized patient.

values in the current study for satisfaction and self-confidence were 0.94 and 0.87 respectively.

2.3.5. Simulation design scale (SDS)

The original scale was developed by Jeffries and Rizzolo (2006) and was adapted to Turkish as conducted by Unver et al. (2017). The scale is valid and reliable for Turkish society. The SDS is a 20-item scale designed to measure constructs from the simulation modality. The design features rated by the students include objectives and information, student support, problem solving, guided reflection or feedback, and fidelity. Unver et al. (2017) was found the Cronbach's alpha values as 0.86. The Cronbach's alpha values in the current study was 0.92.

2.4. Study preparation

2.4.1. The applying the moulage

The IV therapy complications were simulated by applying moulage techniques by researcher. In the HS, the second-degree infiltration moulage was applied on the dorsal hand area of SPs during the simulation practice. In the evaluation simulation performance, the third-degree phlebitis moulage was applied on the dorsal forearm area of SPs. In order to increase fidelity, a cool pack was used in the infiltration and a thermophore was used in the phlebitis.

2.4.2. The determining of infiltration and phlebitis visuals

The researchers identified two volunteer patient who had complications in the clinic, and then consulted another two faculty members about the level and the type of complication. Identified complications were photographed and printed as colored. In the LFS, the second-degree infiltration visual was attached on the dorsal hand area of IV training model (Nasco Life/form®) during the simulation practice. In the evaluation of simulation performance, the third-degree phlebitis visual was attached to the dorsal forearm area of IV training model.

2.5. Procedures

The steps of the research are shown in Fig. 1.

2.5.1. Theoretical lesson

One of the lectures covered in the curriculum of the fundamentals of nursing course is the IV therapy administration. In the implementation stage of the research, all students participated this lecture. The lecture had two main sections. The first section was introduction section to review the main components of anatomy, physiology and pathophysiology relating to IV therapy administration with four-hour theoretical training. The second section was the fundamental concepts of IV therapy and related applications with four-hour theoretical training. It consisted of the IV catheter insertion to start IV therapy administration, maintenance and termination of IV therapy, and classifying and assessment of IV therapy complications. After the lesson, all students were asked to fill the IV therapy administration knowledge test as pretests.

2.5.2. Demonstration practice

Once completed, the students practiced IV therapy administration in the skills laboratory under the faculty members' supervision using demonstration methods. The demonstration consisted of; IV catheter insertion to start IV therapy, maintenance and termination of IV therapy on the mannequin and the IV training arm.

2.5.3. Simulation practice

After the theoretical lesson and demonstration, all of the students participated in a simulation practice, after which their simulation performances were evaluated. This simulation practice was planned to prepare students for simulation performance. The simulation began with a pre-briefing. The HS group practiced with SPs (with IV training arm) and the students in the HS group received feedback from the SPs. The LFS group practiced with the mannequin. The debriefing session was conducted using the plus/delta method (Decker et al., 2013). During the debriefing, the type and degree of IV therapy complications moulage/visual were discussed. After the simulation practice, the Student Satisfaction and Self-Confidence in Learning Scale and the Simulation Design Scale were applied to all of the students.

2.5.4. Evaluation of simulation performance

Two weeks after the simulation practice, the simulation performances of all students were assessed before they practiced these skills on real patients in clinical settings. Both groups were given 15 min to perform the administration of IV therapy including IV catheter insertion and classifying the IV therapy complication. The HS group performed on SPs (with IV training arm), whereas the LFS group on the mannequin. Each student classified the type and degree of IV therapy complication on the moulage/visual. The "IV catheter insertion performance checklist" and "Performance form for assessment IV therapy complication" were used the assessment in the simulation (*first performance score and first classifying score*). Following simulation performance, all the students once more completed the IV therapy administration knowledge test as post-tests.

2.5.5. Evaluation of clinical performance

Students were placed in various clinical settings for four weeks with supervision of faculty members who are responsible for their clinical education. During the clinic hours, 23 students from the HS group and 22 students from the LFS group inserted IV catheter on real patients. IV catheter insertion on patients by students were conducted under the guidance of faculty members. The "IV catheter insertion performance checklist" was used for the assessment of the students in the clinical setting (*second performance score*).

All students who participated in the study classified the type and degree of IV therapy complication on real patient. The researchers identified a volunteer patient in the clinic with complications, and then consulted another two faculty members about the level and the type of complication. IV therapy complication assessment in the clinical setting was performed by the researcher using the "Performance form for assessment IV therapy complication". Each student classified the type and degree of IV therapy complication they assessed on the patient *(second classifying score)*.

2.6. Ethical considerations

This study was approved by the ethics valuation commission involving human participants of the University (reference number 2016–14, January 2016). Written consent was obtained from all volunteered students, SPs and volunteered patients.

2.7. Data analysis

The data obtained were analyzed using the program SPSS/WIN 22.0. General characteristics and dependent variables were tested for homogeneity using the χ^2 test and the independent *t*-test. The difference between groups regarding each variable for the hypothesis test was analyzed by independent t-test, analysis of covariance (ANOVA), and Mann Whitney U and Wilcoxon tests.

3. Results

3.1. Knowledge scores

The differences found between the pre-test scores of both groups in IV catheter insertion knowledge ($t = 0.061$, $p = 0.951$) and IV therapy complications knowledge ($t = -0.107$, $p = 0.915$) were not statistically significant. The differences found between the post-test scores of both groups in IV catheter insertion knowledge ($t = 3.062$, $p = 0.003$) and IV therapy complications knowledge ($t = 3.636$, $p = 0.001$) were statistically significant (Table 2).

3.2. Students' satisfaction and self-confidence level

There were significant differences between the groups in terms of total score (4.67 ± 0.33; 4.24 ± 5.54) ($t = 4.131$, $p = 0.000$). The satisfaction score in the HS group (4.83 ± 0.26) was significantly higher than that in the LFS group (4.40 ± 0.54) ($t = 3.995$, $p = 0.001$). The mean self-confidence score in the HS group (4.55 ± 0.41) was significantly higher than that in the LFS group (4.13 ± 0.46) ($t = 3.741$, $p = 0.001$) (Table 3).

3.3. Simulation design scale scores

Although the HS group had higher scores, no significant difference was found between the groups in terms of total score ($t = 1.409$, $p = 0.164$). Likewise, the subscale scores of support ($t = 1.836$, $p = 0.071$), problem solving ($t = 0.798$, $p = 0.428$), guided reflection or feedback ($t = 0.072$, $p = 0.943$) and fidelity ($t = 1.568$, $p = 0.122$) did not different significantly between the groups (Table 3).

3.4. IV catheter insertion performance score

The mean first performance score for the IV catheter insertion in simulation was 41.17 ± 3.21 for the HS group and 35.54 ± 4.13 for the LFS ($t = 5.826$, p = 0.001). There was a statistically significant difference between the performance score for both groups in simulation (Table 4).

During the clinical practice, the mean of second performance score for the IV catheter insertion was 43.91 ± 2.08 for the HS group and 37.90 ± 4.75 for the LFS group (Z = −4.909, p = 0.001). There was a statistically significant difference between the performance score for both groups (Table 4).

3.5. IV therapy complication classifying score

IV therapy complication was correctly classified by 71% of the students in the HS group and by 45.2% of the students in the LFS group. On the other hand, while 93.5% of the students in the HS group classified IV therapy complication correctly on patient, 29% of the students in the LFS group were found to do so. There was a statistically significant difference between the classify of IV therapy complication levels in simulation and clinical setting for both groups (Table 5).

Table 2
Mean scores of students' knowledge levels.

Groups	n	Mean ± SD	t[a]	p
IV catheter insertion knowledge (pre-test)				
HS	31	60.96 ± 19.38	0.061	0.951
LFS	31	60.64 ± 21.89		
IV therapy complications knowledge (pre-test)				
HS	31	50.56 ± 23.44	−0.107	0.915
LFS	31	51.20 ± 24.01		
IV catheter insertion knowledge (post-test)				
HS	31	82.96 ± 15.53	3.062	**0.003**
LFS	31	68.70 ± 20.61		
IV therapy complications knowledge (post-test)				
LS	31	75.00 ± 15.13	3.636	**0.001**
HFS	31	58.06 ± 21.05		

Abbreviations: SD, standard deviation; IV, intravenous.
[a] Independent *t*-Test.

Table 3
Comparison of groups' satisfaction and self-confidence scale (SSSC) and simulation design scale (SDS) scores.

Items	HS Group n = 31 M ± SD	LFS Group n = 31 M ± SD	t[a]	p
Total Score (SSSC)	4.67 ± 0.33	4.24 ± 5.54	4.131	**0.001**
Student satisfaction	4.83 ± 0.26	4.40 ± 0.54	3.995	**0.001**
Self-confidence in learning	4.55 ± 0.41	4.13 ± 0.46	3.741	**0.001**
Total Score (SDS)	4.63 ± 0.43	4.49 ± 0.35	1.409	0.164
Objectives and Information	4.67 ± 0.38	4.48 ± 0.39	1.847	0.070
Support	4.60 ± 2.02	4.39 ± 0.50	1.836	0.071
Problem solving	4.52 ± 0.53	4.42 ± 0.42	0.798	0.428
Guided reflection or feedback	4.71 ± 0.46	4.70 ± 0.42	0.072	0.943
Fidelity	4.74 ± 0.55	4.48 ± 0.74	1.568	0.122

Abbreviations: SD, standard deviation; HS, hybrid simulation; LFS, low fidelity simulation; SSSC, Satisfaction and Self-Confidence Scale, SDS, Simulation Design Scale.
[a] Independent *t*-Test.

Table 4
Mean scores of students' IV catheterization insertion performance.

Group	IV catheterization insertion score (simulation)			
	n	Mean ± SD	t[a]	p
HS	31	41.17 ± 3.21	5.826	0.001
LFS	31	35.54 ± 4.13		

Group	IV catheterization insertion score (clinical setting)			
	n	Mean ± SD	Z[b]	p
HS	23	43.91 ± 2.08	−4.909	0.001
LFS	22	37.90 ± 4.75		

Abbreviations: SD, standard deviation; IV, intravenous; HS, hybrid simulation; LFS, low fidelity simulation.
[a] Independent *t*-Test.
[b] Mann Whithney *U* Test.

Table 5
Comparison of the correct classifying percentages of the HS and LFS group.

	HS Group n = 31		LFS Group n = 31		χ^2	p
Classifying in simulation (3rd degree phlebitis moulage/ visual)	n	%	n	%	4.239	0.039
Correct classifying	22	71.0	14	45.2		
Incorrect classifying	9	29.0	17	54.8		
Classifying in clinical setting (2nd degree infiltration)	n	%	n	%	27.193	**0.001**
Correct classifying	29	93.5	9	29.0		
Incorrect classifying	2	6.5	22	71.0		

Abbreviations: SD, standard deviation; IV, intravenous; HS, hybrid simulation; LFS, low fidelity simulation.
*Chi-squared test.

4. Discussion

4.1. Knowledge acquisition

The results of the study indicated that the IV therapy administration knowledge level of students in the HS group improved significantly in the pre-test and post-test compared with the LFS group. It was also shown in this study that the knowledge scores of the students in both groups increased after the simulation. Previous studies have demonstrated the benefits of HS methodology and an effective learning environment in improving knowledge levels during nursing education

(Pywell et al., 2016; Sabzwari et al., 2017; Sun-yeun and Mi-ye, 2015). Sezgunsay and Basak (2020) compared the training by moulage and visuals for the assessment of pressure injury, and they found that knowledge increased in both groups but differently that there was no difference between the groups.

4.2. Clinical skills acquisition

The results of the current study revealed that the IV catheter insertion scores of the HS group were significantly higher than LFS group. These findings suggest that the trainings based on HS were successful in transferring the skills acquired in the laboratory to clinical practice. Ko and Kim (2014) investigated the effect of HS on the development of nursing students' basic nursing skills. The results of the study revealed that the intravenous injection and urinary catheterization performance scores of the students trained with HS were significantly higher than those of the LFS group students. There is little information about examining the efficacy of HS in improving students' clinical skills for IV catheter insertion. A recent study by Takmak et al. (2021) found that no significant difference between the traditional group and the HS group performance on the skills and attitudes of IV insertion in nursing students.

4.3. SSSC and SSC

The findings showed that the students' scores in student SSSC is statistically higher in simulations using HS than in those in LFS groups. HS group students experienced learning environment where they could communicate with SPs and had increased fidelity with moulage. HS group students also received feedback by the SPs on their performance. In previous studies comparing different types of simulation in terms of SSSC scores of high fidelity were found to be similarly higher (Basak et al., 2016; Lubbers and Rossman, 2017). There is little information about examining the compare of HS and LFS simulation in improving students' satisfaction and self-confidence level. However, studies indicated that HS allows students to increase their self-confidence by increasing their self-efficacy before clinical practice (Cohen et al., 2012; Unver et al., 2018).

The implementation of the simulation design elements was evaluated by the students and both groups had high scores. Total scores on the SDS total and subscale scores of the HS group were higher but this was not significant. However, other studies have concluded that high fidelity simulation education increased the simulation design element scores of nursing students (Basak et al., 2016; Wang et al., 2015). Although the students participating in our study experienced simulation at different fidelity levels, they had no prior experience with simulation. This may have led to the conclusion that simulation design features were performed in the best way in both groups.

4.4. Clinical assessment skills acquisition

The results of this study showed that the classifying of IV therapy complication type and levels obtained by the HS group that used moulage were significantly higher than those in the LFS group that used visuals. The fidelity must be sufficient to engage learners, allow transfer of acquired skills. In our study, infiltration and phlebitis moulages were applied on the SPs' skin using materials wax which gives realistic effect. In addition, thermophore/cool pack was used in order to feel hot/cold when palpated. Thus, we expected that using visual and tactile fidelity in simulation would increase students' clinical assessment level. The results of our study show that use of visual as instructional material can be insufficient to develop students' clinical assessment for IV therapy complications. Flores and Hess (2018) conducted that to determine whether using SPs dressed in moulage improves pharmacy students' ability to assess skin disorders compared to using picture-based paper cases. In this study, SPs with moulage did not improve students' visual ability to assess skin disorders compared to using picture-based paper cases. However, students preferred SPs with moulage when learning assessment of skin disorders. A recent study by Sezgunsay and Basak (2020) found that the simulation with moulage was effective methods in improving the skills of nursing students' skills to assess pressure injury. Other studies in the literature indicate that the inclusion of moulage in simulations is effective way to develop students' self-confidence, increase their knowledge and self-efficiency levels (Hernandez et al., 2013; Mazzo et al., 2018; Pywell et al., 2016; Scholtz et al., 2016; Seckman and Ahearn, 2010; Sezgunsay and Basak, 2020).

5. Limitations

Firstly, during the process of four weeks of clinical practice, not all the students in the study sample had a chance to practice IV catheter insertion on real patients. The reasons for this were that some of the patients had IV insertion difficulty, and some patient refused IV catheter insertion by student nurse. Secondly, the skill checklists form was developed according to literature by the researchers. Although, the content validity of these forms was established, we did not assess inter rater reliability.

6. Conclusions

Our results demonstrated that the use of HS is more effective than the use of LFS on development of student's intravenous therapy administration knowledge, performance and clinical assessment level. The findings also indicated that the students' satisfaction and self-confidence level in learning is statistically higher in simulations using HS than in those in LFS groups. These results demonstrate that not only the simulators, but the simulation environment must also be improved in terms of the fidelity in simulation practices carried out in nursing education. In this respect, it is recommended that simulation practices should be integrated into the instructional process of IV therapy administration skills within nursing education. Further studies with larger samples are needed to evaluate effecting simulation strategies on students' performance in the clinical environment.

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CRediT authorship contribution statement

All of the authors have contributed to the study on conception and design, drafting the article, revising it critically for important intellectual content, and final approval of the version to be published. All authors are in agreement with the content of the manuscript.

Declaration of competing interest

None of the authors have conflicts of interest to disclose. None of the authors have any relevant financial disclosures.

Derya Uzelli Yılmaz: Conceptualization, Methodology, Data collection, Writing- Original draft preparation.

Dilek Sarı: Conceptualization, Methodology, Data curation, Supervision, Writing- Reviewing and Editing.

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