

Effectiveness of Hybrid Simulation in Developing Intramuscular Injection Skills: A Randomized Clinical Trial

Abstract

Background: Intramuscular injection (IMI) is a complex skill that requires knowledge, problem-solving ability, and practical competency. The use of the hybrid simulation (HS) method in nursing education allows students to develop their procedural and operational skills in a safe and realistic environment.

Aim: This parallel-randomized and clinical trial was evaluating the effect of HS on IMI knowledge, skills, self-confidence, and satisfaction levels of nursing students.

Methods: Students were randomly assigned to either the intervention group (n=63) or the control (n=63) group. Students in the control group practiced IMI on a partial task trainer, whereas students in the experimental group practiced on HS (a digital half Buttock-mate IMI simulator-standardized patient). Data were collected with IMI Knowledge Test, IMI Skill Checklist, and the Student Satisfaction and Self-Confidence in Learning Scale. The data were analyzed using mean, median, number, and percentage values, Independent Sample t-test, Mann-Whitney U-test, Friedman test, and Chi-square tests.

Results: The mean age of the students was 19.37 ± 0.68 in the intervention group and 19.54 ± 0.86 in the control group. The majority of students were female in both groups (intervention group=81%, control group=82.5%). The effect size of the IMI knowledge test (post-test) score ($d=0.31$) and IMI administration skill ($d=0.71$) of this study was medium, the effect size of satisfaction with learning ($d=1.64$) and self-confidence ($d=1.82$) was found to be strong. The students stated that the simulation provided a realistic environment, they were nervous during the simulation, and HS training was beneficial.

Conclusions: The HS method increased the performance of students in IMI was effective on self-confidence and satisfaction in learning, but it did not improve knowledge acquisition compared to the traditional method. The findings suggest that the use of HS is an effective educational technique in IMI skill training.

Keywords: Hybrid simulation, intramuscular injection, nursing education, nursing students, simulation training,

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Introduction

Medication administration by intramuscular injection (IMI) is a complex skill. If not applied with the correct technique, complications such as muscle contracture, nerve damage, pain, and abscess may develop.¹ It is very important for students to acquire IMI skills before graduation so that they can take responsibility for such a vital practice, which is among the duties, authorities, and responsibilities of nursing. Studies revealing the knowledge of nursing students and nurses on IMI² indicate that knowledge acquisition is not at the desired level. It is very important that students acquire nursing skills at the desired level, as this reduces the risk of harm to patients while applying these skills.³ Having sufficient knowledge and skills of students plays a key role in maintaining professional competence, preventing complications, and ensuring patient safety.⁴ Students need to acquire this basic skill before proceeding to clinical practice. During clinical practice, students may experience stress and anxiety when confronted with a real patient. It is also stated that when students' self-confidence level increases, they experience less stress and anxiety in clinical practice.⁵

Nurse educators have increasingly started to use simulation. The use of simulation in nursing education helps students improve their knowledge, skills, and self-confidence⁶ and enables students to integrate their knowledge and skills.⁷ The simulation method

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is where the learner must act out a clinical scenario while engaging in problem-solving and decision-making.⁸ It also actively involves students in the learning processes and students' mistakes can be immediately corrected during the simulation.⁹ Used to increase realism during education, hybrid simulation (HS) can provide realistic opportunities for students to administer medication to patients safely.¹⁰ HS is a simulation that is used with a standardized patient (SP) combined with wearable technologies or a model,¹⁰ thus allowing students to develop their procedural and operational skills.¹¹ In addition, it is an important method in terms of providing students with the opportunity to acquire clinical and communication skills in a safe environment in conditions that do not threaten the rights and security of the patients.¹²

Nursing and medical education researchers report that HS is a very advantageous approach for both students and instructors with positive outcomes such as improvement in skill performance, increase in knowledge, development of critical thinking skills, and establishment of a strong sense of trust.^{13,14} HS has been used in teaching many skills such as urinary catheterization,¹³ intravenous catheterization,¹⁵ and breast examination.^{10,14} However, in the literature, there is no study evaluating the efficacy of HS training in providing IMI knowledge and skills. In addition, professional training is very important in integrating knowledge and practice to reduce the error rate of drug administration and to ensure patient safety. For this reason, different teaching methods that can guide educators in developing students' skills should be applied. This study aimed to determine the effect of HS on IMI knowledge, skills, self-confidence, and satisfaction levels of nursing students.

Hypotheses of the Study

H1: The IMI knowledge test mean scores of the nursing students who are trained using HS method were higher than nursing students who are trained with the traditional method.

H2: The IMI administration skill mean scores of the nursing students who are trained using HS method were higher than nursing students who are trained with the traditional method.

H3: The self-confidence of the nursing students in the HS group about administering the IMI was higher than the nursing students in the traditional method group.

H4: The satisfaction levels of the nursing students in the HS group about IMI administration were higher than the nursing students in the traditional method group.

Materials and Methods

Design and Participants

A randomized clinical trial design was used. The study was registered ClinicalTrials.gov (Registration: NCT04464018–July 9, 2020) and full study protocol can be accessed from the registration website (<https://clinicaltrials.gov>). This study conformed with reporting guidelines for health-care simulation research: extensions to the CONSORT statements.¹⁶

Study Setting and Sample

This study was conducted by 2nd-year students in a Bachelor of Nursing degree program during the first semester of the 2018–2019 educational year. The sample size was calculated using the G*Power

V.3.1.9 computer program. Assuming a moderate level effect size between the groups ($d=0.5$), to achieve 80% power at 95% confidence interval, power analysis revealed that the minimum required sample size in each group would be at least 51 students should be included in each group. Considering that there may be losses, 12 students were added to each group. We assessed for eligibility who were registered to the Fundamentals of Nursing course ($n=172$). Inclusion criteria for the study were (1) voluntary acceptance of study participation and (2) did not have prior IMI skills training and clinical experience.

Randomization and Blinding

Randomization

All 2nd-year nursing students who met the inclusion criteria for randomization were included in the study. Of the 126 students who met the criteria were included and randomly assigned, list into two equal groups (intervention group ($n=63$), control group ($n=63$)) with IBM Statistical Package for the Social Sciences statistics Version 25 software package (IBM SPSS Corp.; Armonk, NY, USA). While preparing the randomization table, age and gender were taken into account. The number of students in each group was calculated to each group was determined so that these variables would be distributed similarly in both groups, and assignments were made according to these numbers. For example, four people with 18-year-old and male were randomly assigned to two groups in order of arrival. Hence, the stratified randomization technique is used. This method was gradually made in such a way that each group had its own subgroup. The randomization list was kept by an independent researcher (not included in the study) and the assignment code of each student to one of the two groups was announced before the laboratory course.

Blinding

In the research, blinding was done at the data collection and statistical analysis stage. In the research, the application of the questionnaires to the students and the evaluation of their IMI administration skills were carried out by two expert trainers who did not know the students in the intervention and control groups working in the Department of Nursing Fundamentals. Data entry was entered by someone other than the researcher, coding as intervention Group "A" and control Group "B." The statistics were made by a statistician who did not know the coding for the intervention and control groups.

Instruments and Training Aids

Sociodemographic Characteristics Form

It consisted of six questions including the age, gender, and opinions of the students about the nursing profession.

IMI Knowledge Test

To objectively evaluate the knowledge of students regarding IMI (pre-test-midtest-post-test). Target behaviors for the test content includes general information about IMI, injection sites, complications, administration, and evaluation of the administration result. Test consists of 21 items and total score of the test was 21. The average item power of the test was 0.59 and The Kuder Richardson-20 reliability coefficient was 0.71.¹⁷

IMI Skill Checklist

To objectively evaluate the performance of students regarding IMI administration skills, a form consisting of 39 administration steps was created by the researcher in line with the literature on the subject. Five faculty members who are specialists in the Fundamentals

of Nursing (PhD, RN) evaluated the checklist to ensure the content validity before the interventions. At each step of the procedure, the steps are graded as “fully completed”, “partially completed”, “not performed”. The highest score that can be obtained from the checklist is 100 and the lowest score is 0.

Student Satisfaction and Self-confidence in Learning Scale

It is a scale developed to measure students' attitudes and beliefs about simulation.¹⁸ The scale was adapted to Turkish by Karaçay and Kaya (2017). It is a 5-point Likert type scale. The scale consists of two sub-dimensions, “satisfaction with learning” and “self-confidence”, and a total of 13 items. Answer options can be marked from “5=strongly agree” to “1=strongly disagree”. Its Cronbach's alpha value was 0.90.¹⁹

Two-Column-Writing Example

It was used to record the personal reactions and reflections of the intervention group on the learning content or method before the debriefing phase.²⁰

Scenario and Standardized Patient Education

The scenario was written as a case in which a patient with severe pain who had surgery on the right knee had to be administered narcotic analgesics as an IMI. In the scenario, the Standardized Patient's (SP) age, marital status, educational background, etc. sociodemographic characteristics; information such as previous diseases and hospitalization status, vital signs were recorded. The prepared scenario was revised in line with faculty members (PhD, RN) opinions. The pilot study was conducted with ten nursing students of the same grade from a different university.

Two SPs trained for HS implementation took part. Before the application, these SPs were briefed on the purpose, method and scenario of the research, and they were asked to not deviate from the written scenario and not give any additional information unless the student asked. In addition, a pilot study was conducted with these SPs. SPs participated in the study voluntarily and were not paid.

Procedures

Procedures of the study are presented in Figure 1. Before the theoretical course, all students filled the sociodemographic characteristics form and the IMI knowledge test (Pre-test).

Theoretical Course

The researcher explained the IMI sites, complications, administration method, and unexpected results related to injection to the students (n=172) who took the entire nursing fundamentals course, through a PowerPoint® presentation and videos in two class hours. After the course, IMI knowledge test (Midtest) was applied again to all students. After the theoretical course, the students were allocated to intervention (HS) and control (Traditional method) groups using a randomization method.

Laboratory Course

Four faculty members supported laboratory/simulation course. All faculty members who would support the course were given training so that each student could receive education with a standard method. The students were divided into 16 subgroups (intervention eight groups, control eight groups), each consisting of seven to eight students, for the laboratory course. Two days were determined for

laboratory/simulation course, and the course days and hours were informed in advance to the groups.

Control Group

In the laboratory, the group faculty member explained the skill with the intramuscular hip injection model by applying the steps of the “IMI Skill Checklist”. The students practiced the skill on the intramuscular hip injection model one by one, and during this process, incomplete or incorrect performance by students was intervened by the faculty members. Free working hours were assigned to the students under the supervision of a faculty member to repeat the IMI on the model. The application took approximately 2 h for each group.

Intervention Group

In the laboratory, the group faculty member explained the skill with the intramuscular hip injection model by applying the steps of the “IMI Skill Checklist”. Simulation applications were carried out in a skill laboratory designed as a private patient room. In line with the scenario prepared for HS application, the digital half hip simulator was mounted on the body of SPs, allowing IMI administrations.

Before the simulation started, the students were briefed about the SP's history, vital signs, characteristics and the scenario, and the roles they would take in the scenario, how many minutes to complete the scenario, and the goals to be achieved during the scenario were mentioned. In addition, to protect the security and integrity of the simulation environment, a reality and confidentiality agreement was made with the students. At the same time, students' feelings about the simulation were shared and their questions were answered. No facilitator was used during the simulation as it was not needed in the scenario. While the students performed the IMI application with HS method one by one, videos of each student were recorded simultaneously. Each student's simulation application took approximately 8–10 min.

After the students finished the HS application, they went to the debriefing room and watched their own videos. After watching the video, the students filled in the two-column-writing example.

The debriefing was made immediately after the simulation. The debriefing session includes going over the goals of the experience and remembering the events in the simulation.²¹ Thanks to the reflections during debriefing, learning can become permanent and the critical thinking skills of the students as well as their problem-solving skills can further develop.²⁰ The plus-delta method was used in the debriefing session. A two-column script example was used so that students could write what went well during the simulation or activities that could have been done better or done differently. In two-column-writing example, the page was horizontally divided into two, and two questions were asked on the right and left sides of the page. In this scenario, students were asked to define the administration steps they thought to be successful (left column), to explain all the steps they followed in the administration (left column), what they felt during the administration about the simulation method (right column), what kind of changes they would make if they were to perform the administration again (right column). Students were asked to self-evaluate by identifying what went well or could be better during the simulation. Students were given feedback on their performance on the application. The debriefing session lasted approximately 20–30 min with the participation of all students (7–8) in the group.

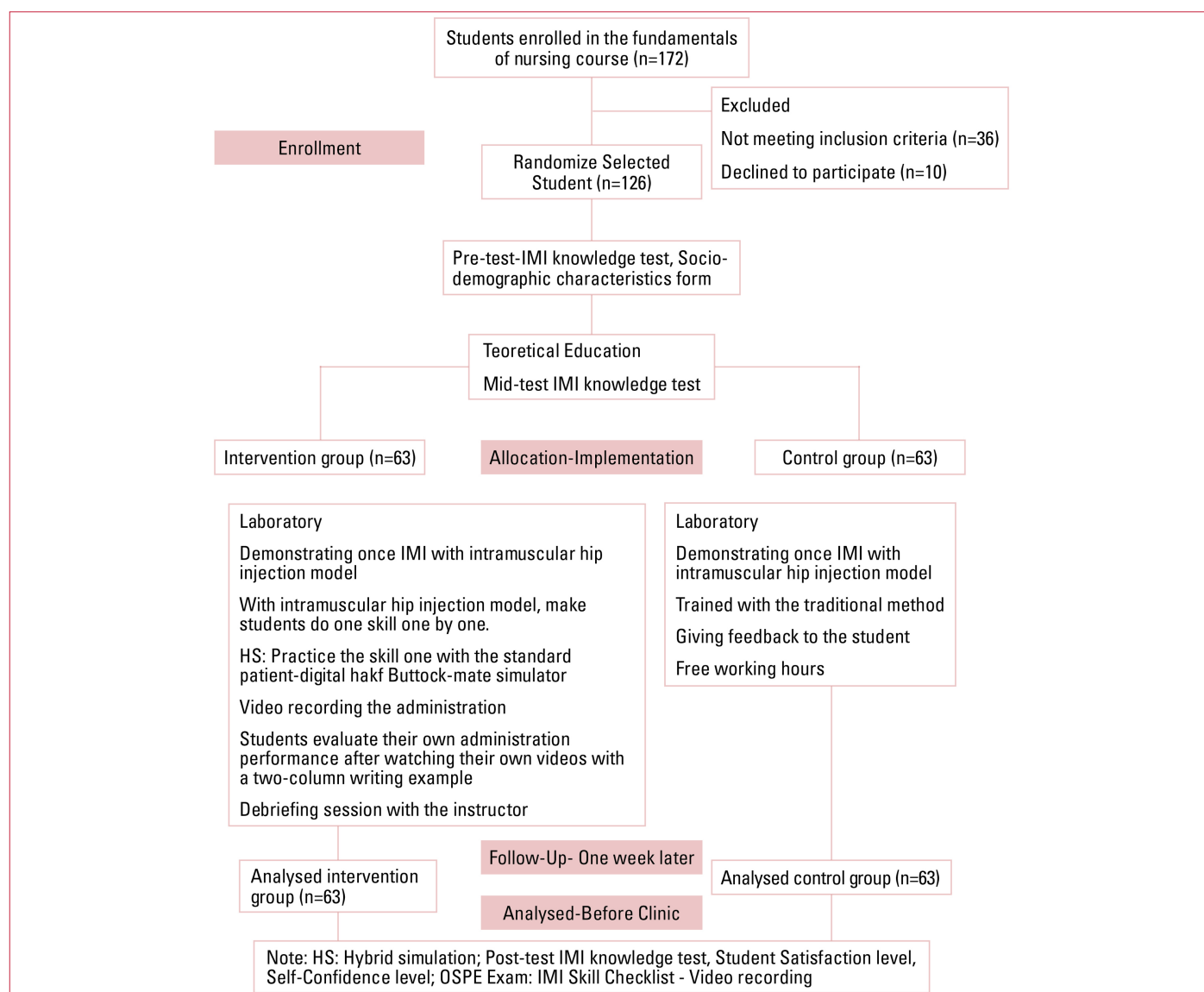


Figure 1. The flow diagrams of the students through each stage of the study.

Students in both groups who completed the laboratory applications repeated the group application they were assigned to in the follow-up 1 week later, under the supervision of faculty members. All students completed the IMI Knowledge Test (Post-test) and SCLS after the laboratory applications were completed.

Before starting clinical practice, objective structured practical examination (OSPE) was applied to all students in the skills laboratory to evaluate IMI skill. In the OSPE examination, intramuscular hip injection models were used for intervention and control group. The administration performances of all students were recorded on video. The video recordings of the students were independently evaluated by two faculty members other than the researcher, using the IMI Skill Checklist. Skill assessment was based on these records.

Statistical Analysis

The data were analyzed with the IBM Statistical Package for the Social Sciences Statistics Version 25 software package (IBM SPSS Corp.; Armonk, NY, USA). Continuous variables were evaluated by mean $\pm$ standard deviation and median (minimum-maximum), and categorical variables were evaluated by number and percentage. When the parametric test assumptions were met; Independent Sample's t-test; if were not met, the Mann-Whitney U-test was used to compare independent groups. For the repeated measures, when parametric test assumptions were met to compare dependent groups analysis of variance; if were not met, Friedman test was used. Cohen d was used to calculate effect sizes (comprehensive meta-analysis Version 3). Cohen states that if the d value is <0.2 , the effect size can be defined

Table 1. Sociodemographic characteristics of groups intervention versus control

	Intervention group (n=63)		Control group (n=63)		Test and P	
	Mean±SD	median (min-max)	Mean±SD	Median (min-max)	z0	P*
Age	19.37±0.68	19 (18-21)	19.54±0.86	19 (18-23)	-0.903	0.366
	n	%	n	%	χ^2	P**
Sex						
Female	51	81	52	82.5	0.053	0.818
Male	12	19	11	17.5		
Graduated high school						
Normal high school	4	6.3	0	0	4.667	0.097
Anatolian high school	49	77.8	49	77.8		
Other	10	15.9	14	22.2		
Seeing the profession as appropriate for oneself						
Yes	36	57.1	39	61.9	0.537	0.762
No	2	3.2	1	1.6		
Partly	25	39.7	23	36.5		
Willingly choosing a profession						
Yes	33	52.4	32	50.8	0.036	0.982
No	6	9.5	6	9.5		
Partly	24	38.1	25	39.7		
Overall academic average						
3.51-4.00	2	3.2	3	4.8	5.789	0.301
3.01-3.50	17	27.0	17	27.0		
2.51-3.00	22	34.9	31	49.2		
2.26-2.50	13	20.6	9	14.3		
2.01-2.25	5	7.9	1	1.6		
1.01-2.00	4	6.3	2	3.2		

Note. *Mann-Whitney U-testi, **Pearson Ki Kare.

Table 2. Comparison of students' intramuscular injection knowledge, administration skill, satisfaction with learning, and self-confidence scores of the intervention and control groups

Scores	Intervention Group (n=63)		Control Group (n=63)		Test and p	
	Mean±SD	median (min-max)	Mean±SD	Median (min-max)	Between groups analysis	Cohen d (%95 CI)
IMI knowledge pre-test	7.17±2.45	7 (2-13)	7.56±2.23	8 (3-13)	t=-0.913 P=0.363	
IMI knowledge midtest	13.03±2.56	13 (7-17)	14.05±2.99	14 (7-20)	z=-0.042 P=0.041	
IMI knowledge post-test	16.02±2.04	16 (11-19)	15.29±2.68	16 (7-20)	z=-0.269 P=0.204	0.31 (-0,04-0,66)
Within groups analysis	$\chi^2=120.033$; P=0.001		F=253.209; P=0.001			
IMI administration skill	85±7.4	86 (66-98)	79±9.4	81 (53-95)	z=3.391 P=0.001	0.71 (0.35-1.07)
Satisfaction	24±1.2	25 (21-25)	21±2.3	21 (15-25)	z=-6.956 P=0.001	1.64 (1.23-2.04)
Self-confidence	37±2.2	38 (31-40)	32±3.2	32 (24-40)	z=-7.148 P=0.001	1.82 (1.41-2.24)

IMI: Intramuscular injection, χ^2 : Friedman test, F: Analysis of variance in repeated measures, t: Independent sample t-test, z: Mann-Whitney U-test.

as weak, if it is 0.5, it is medium, and if it is >0.8 , it can be defined as strong.²²

The students' group statements about their feelings while administering IMI using the HS method were evaluated by two-column-writing example. Content analysis and codes were created manually for the data obtained from this example. Students' opinions regarding the codes created were evaluated by frequency and percentage. Inter-rater reliability for the video recording of the students during IMI was evaluated with the Kappa coefficient. Due to the high agreement between the observers, the evaluation of the first observer was used in the analyses. $P < 0.05$ was accepted as statistically significant.

Ethical Considerations

This study was registered at Clinicaltrials.Gov (Registration Number: NCT04464018, Date: 09.07.2020). Ethical approval was obtained from the Pamukkale University's Non-Interventional Research Ethics Committee (Approval Number: E-60116787-020/4308, Date: 16.01.2018) and institutional permissions were obtained from the where the study was conducted. The study conformed to the principles of the Declaration of Helsinki. Permission to use "SCLS" was obtained from the authors. Students who accepted to participate in the study were informed and their verbal and written consents were obtained.

Results

All the students included in the groups completed the study. The mean age of the students was 19.37 ± 0.68 in the intervention group and 19.54 ± 0.86 in the control group. The majority of students were female in both groups (intervention group=81%, control group=82.5%). There was no significant difference between the groups in terms of demographic characteristics ($P > 0.05$) (Table 1).

IMI knowledge test score was compared before the theoretical course (Pre-test), after the theoretical course (Midtest), and after practice (Post-test). There was no significant difference between the Pre-test ($P = 0.363$) knowledge scores of the intervention and control group. The mean scores of the IMI knowledge test increased in the midtest

(intervention $n=13.03 \pm 2.56$ and control= 14.05 ± 2.99) and post-test (intervention $n=16.02 \pm 2.04$ and control= 15.29 ± 2.68) within the groups, and a significant difference was observed ($P = 0.001$). The effect size of the IMI knowledge test in the post-test ($d=0.31$) was moderate (Table 2).

IMI administration skill mean scores were higher in the intervention group (85 ± 7.4) compared to the control group (79 ± 9.4), the difference was significant ($z = -3.391$, $P = 0.001$) and the effect size was moderate ($d=0.71$).

The intervention group's satisfaction with learning mean score (24 ± 1.2) was higher than the control group's (21 ± 2.3) ($P = 0.01$) and the effect size ($d=1.64$) was strong. The intervention group's self-confidence mean score (37 ± 2.2) was higher than the mean score of the control group (32 ± 3.2), and the effect size ($d=1.82$) was strong (Table 2).

Almost all of the students in the intervention group (90.4%) stated that they were nervous while practicing with the simulation method, it was a useful and good method for learning (30.1%), and the practice provided a realistic environment (25.3%) (Table 3).

Discussion

In this study, while the effect size of IMI knowledge and IMI administration skill was medium in post-test scores, the effect size of satisfaction with learning and self-confidence was found to be strong.

Furthermore, an increase in the level of knowledge was found in both groups. In other training studies planned to improve IMI skill, the post-training knowledge scores were found to be higher than the pre-training scores.²³ A study using HS and task-trainer modes to train nursing students in the use of pulse oximetry and aspiration after cardiac arrest also showed that overall effect sizes on knowledge and skill were high.²⁴

It was determined that the skill realization level of the students who used the HS method was significantly higher than the students who used the traditional method. The results of a meta-analysis showed that the effect size of the HS method is strong than the low-reality simulation method in terms of psychomotor skill development.²⁵

In other studies, it was observed that the use of SPs in educational settings in combination with auxiliary tools is effective in developing students' psychomotor skills before clinical practice.^{10,13,14,24} It was shown that the use of SPs in undergraduate nursing programs can improve clinical judgment and increase students' scores in final performance evaluations.²⁶ In addition, in the debriefing session of this study, the students had the opportunity to watch their practices from the video and to see their mistakes, which increased awareness among the students. Consistent with the results of Grant et al. (2014), it can be said that such a practice affects students' performance positively.²⁷ Furthermore, Yeun et al. (2020) in their study to determine the models of video-facilitated debriefing (VFD) perceptions of nursing students after simulation, most of the nursing students stated that VFD was an opportunity to review and reflect on professional skills.²⁸

In the present study, students' satisfaction with learning and self-confidence mean scores were significantly higher than the control group, and effect sizes were strong. One of the positive aspects of simulation applications is that it increases students' satisfaction and self-confidence.^{14,26,29} Education with simulation method equips students with skills that they can transfer to the clinical setting and

Table 3. The intervention group students' statements about administering intramuscular injection using the hybrid simulation method ($n=63$ *)

Feelings about the simulation method**	n (%)
Excitability	57 (90.4)
A realistic environment	16 (25.3)
Being a useful and good method for learning	19 (30.1)
Nice experience	13 (20.6)
Feel scared and nervous	9 (14.2)
Feel stressed and anxious	12 (19.0)
Provide an opportunity to see errors	3 (4.7)
Feel like a real nurse	5 (7.9)
Feel comfortable	5 (7.9)
Feel unsuccessful	2 (3.1)

Note. *Percentages are taken from n, **Multiple responses have been given.

increases their self-confidence by improving their clinical decision-making ability and critical thinking skills.³⁰

Studies in the literature concluded that the use of wearable technologies by a SP to improve students' self-efficacy is as effective as using a model, and the performance of students in patient-care interaction in clinical practice is superior.^{10,15} In a study using HS and low fidelity simulation to improve IV therapy administration skills of 1st-year nursing students, satisfaction and self-confidence scale scores of students in HS were found to be significantly higher than those in the LFS group.³¹

It was also found that HS strengthened communication and students were more willing to talk to SP and this increased their motivation.^{14,15} The fact that the HS method provides students with the opportunity to perform skills and practices in a safe, realistic environment on human beings increases the students' confidence and satisfaction.¹³

Reflection, which is the highest level of reasoning and learning, is part of active learning together with discovery, interpretation, and problem-solving stages.³² Therefore, reflecting on what you have learned has an important place in effective learning. In the present study, a two-column writing example was used to improve students' reflection skills, and the students in the intervention group were asked to write what they felt during the IMI application. Almost all of the students in the intervention group stated that they were very nervous during the training with simulation. In other study, students were recorded on video during practice and stated that they did not feel comfortable and safe while practicing with the SP,³³ which support our findings. In addition, the students in the present study stated that the training environment was similar to the real environment. The use of SPs increases the realism of the training, especially in interactions with the patient, and engages the feelings of the learner through the learning experience.¹⁰ HS allows training in both procedural and communication skills, bringing a sense of realism to training that cannot be achieved using only SPs or simulators.³⁴ It is also stated that the HS approach provides an enhanced realism and therefore provides a more unique learning context without putting real patients at risk.³⁵ HS training was shown to be a method that eliminates the deficiencies of models by adequately reflecting the nurse-patient interaction in a realistic way.¹⁵

Limitations

Since the study was conducted in the nursing department of only one university, the results of the study are limited to the nursing department students at the relevant university and cannot be generalized. Due to the nature of the intervention, participants could not be blinded during the laboratory application phase.

Conclusion

The HS method increased the performance of nursing students in IMI and was effective on self-confidence and satisfaction in learning, but it did not improve knowledge acquisition compared to the traditional method. In addition, the students who received training with the HS method stated that they were very nervous, but it provided a realistic environment that it was a useful, good method, and a good experience for learning. As demonstrated by our study, the HS method as an approach in skills training can help bridge the gap between theoretical education and practice in nursing. We are of the

opinion that further studies should be conducted on larger samples that examine the effect of the HS method on students' knowledge acquisition, and evaluation methods in accordance with the learning objectives of simulation methods should be developed. Furthermore, future studies should examine the effects of clinical simulation on students' knowledge acquisition and skill development both before and after clinical practice.

Ethics Committee Approval: Ethical approval was obtained from the Pamukkale University's Non-Interventional Research Ethics Committee (Approval Number: E-60116787-020/4308, Date: 16.01.2018).

Informed Consent: Verbal and written informed consent was obtained from the nursing students who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - A.S.Z., N.K.K.; Data Collection and/or Processing - A.S.Z.; Literature Search - A.S.Z., N.K.K.; Analysis and/or Interpretation: A.S.Z., N.K.K.; Writing- A.S.Z., N.K.K.; Critical Review - A.S.Z., N.K.K.

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