Nurse Education Today 94 (2020) 104572

Contents lists available at ScienceDirect

Nurse Education Today

journal homepage: www.elsevier.com/locate/nedt

Is Moulage effective in improving clinical skills of nursing students for the assessment of pressure injury?

Emine Sezgunsay[a,1], Tulay Basak[b,*]

[a] University of Health Sciences Turkey, Gulhane Training and Research Hospital, Stoma and Wound Care Centre, Ankara, Turkey
[b] University of Health Sciences Turkey, Gulhane Faculty of Nursing, Fundamentals of Nursing Department, Ankara, Turkey

ARTICLE INFO

Keywords:
Moulage
Simulation
Pressure injury
Nursing students

ABSTRACT

Background: In wound care simulations, the practice can be performed on 3D-wounds formed by moulage. Moulage helps the student to perceive the etiology, physiology, and healing processes of the wound, and it can also be used to improve the students' wound assessment skills.
Objective: The aim of this study is to investigate the effectiveness of moulage in the improvement of pressure injury assessment skills of nursing students.
Design: A quasi-experimental study.
Settings: A nursing faculty at a public university.
Participants: All fourth-year students ($n = 73$) who take the simulation elective course were invited to participate.
Methods: Fall semester students ($n = 38$) constituted the control group and spring semester students ($n = 35$) formed the intervention group. The coin-flipping method was used to match the education period and student groups. The intervention group simulation was performed using moulage, and the control group simulation was performed using a pressure ulcer visuals. The same simulation scenarios were used for both groups. The data were collected using the Simulation Design Scale, Student Satisfaction and Self-Confidence Scale, and student identification form, knowledge test, performance checklist and feedback form developed by the researchers.
Results: Students' knowledge scores for pressure injury assessment have improved significantly in both the intervention group (pre-test:61.71 ± 9.77 and post-test 70.57 ± 12.53, $t = -4.27$, $p < 0.001$) and the control group (pre-test: 66.81 ± 13.47 and post-test 73.06 ± 15.50, $t = -2.34$, $p = 0.02$). Laboratory and clinical pressure injury assessment skill scores of the intervention group students were significantly higher than the control group. Besides, the correct staging percentages of the intervention group students are higher than the control group students during the clinical practice ($\chi 2 = 5.05$, $p = 0.02$).
Conclusions: It can be concluded that the simulation with moulage was effective in improving the skills of nursing students who received training for pressure injury assessment and in transferring what they learned to the clinical setting.

1. Introduction

Pressure injuries, which are among the quality indicators in the health care system, are a serious patient safety problem that affects the duration of hospital stay and cost of care (Barakat-Johnson et al., 2018). A pressure injury is defined as a localized injury caused by a pressure or shearing force usually occurring over a bony prominence (NPUAP, 2014). Studies on pressure injuries report a prevalence of pressure ulcers ranging from 3.4 to 32.4% worldwide (Anthony et al., 2019).

The systematic staging of pressure injuries is an important assessment that affects the treatment process and prognosis (Edsberg et al., 2016). Although staging is perceived as a simple skill, errors can be made in this process since it requires a certain level of experience. Bruce et al. (2012) state that stage 2 pressure injuries are mostly confused with stage 1 by nurses. Accurate and reliable pressure injury documentation is important for the proper use of financing transferred to healthcare as well as the implementation of appropriate prevention and

* Corresponding author at: University of Health Sciences Turkey, Gulhane Faculty of Nursing, Fundamentals of Nursing Departmnet, Ankara, 06010 Etlik/Ankara, Türkiye.
E-mail address: tulay.basak@sbu.edu.tr (T. Basak).
[1] Gulhane Teaching and Research Hospital - Stoma and Wound Care Centre 06010 Etlik/Ankara, Türkiye.

https://doi.org/10.1016/j.nedt.2020.104572
Received 23 December 2019; Received in revised form 24 June 2020; Accepted 26 July 2020

treatment interventions (Bruce et al., 2012; Spear, 2013). It also provides common language use among nurses and other health care professionals. Nurses undertake most of the responsibility during the prevention, treatment and care of pressure injuries, and appropriate nursing care that increases the quality of nursing care (Samuriwo and Dowding, 2014). Therefore, it is important to improve pressure injury assessment skills of nurses before and after graduation. In order to develop these skills, nurse educators need to provide adequate clinical experience to student nurses. However, due to the limited opportunities for developing these skills, the high number of students, the complexity of the health system and patient safety problems, difficulties may occur in developing psychomotor skills in clinical settings (Yuan et al., 2012; Durmaz Edeer and Sarıkaya, 2015; Labrague et al., 2019). For this reason, the importance of simulation-based education, which provides practice similar to clinical experience, continues to increase (Moule, 2011; NCSBN, 2014). In 2014, the International Nursing Association for Clinical Simulation and Learning (INACSL) provided strong evidence in a national study that high-fidelity simulation experiences can be effectively substituted for traditional clinical experience (NCSBN, 2014).

The results of simulation-based education in nursing studies have demonstrated that simulation is a powerful learning tool to enhance nursing students' theoretical knowledge and psychomotor skills, self-confidence, critical thinking, clinical reasoning and judgment, and motivation (Durmaz Edeer and Sarıkaya, 2015; Moule, 2011; Woodruff et al., 2017; Labrague et al., 2019). Simulation-based education allows students to perform less common practices in clinical settings in a controlled environment without causing harm to patients or other students (Mazzo et al., 2017). Besides, simulation-based education improves the communication skills that students will use when interacting with patients and other healthcare professionals (Mazzo et al., 2017; MacLean et al., 2017). Simulation-based education for the acquisition of knowledge and skills in nursing education is recommended by the World Health Organization (2009) and the National League for Nursing (NLN) (2005).

Moulage plays an important role in the high-fidelity simulations that addresses multiple sensory organs (Stokes-Parish et al., 2019). The use of moulage provides a valuable opportunity for practice experience that can be sensed by many sensory organs such as vision, hearing, and touch. In wound care simulations, the practice can be performed on 3D-wounds formed by moulage. Moulage helps the student to perceive the etiology, physiology, and healing processes of the wound, and it can also be used to improve the students' wound assessment skills (Edwards and McCormack, 2018). Studies have shown that when simulation is used for skin lesions and wound care training, students gain self-confidence through realistic experiences (Hernandez et al., 2013; Smith-Stoner, 2011; Edwards and McCormack, 2018).

Kirkpatrick's four-level approach has been used as a model for evaluating the outcomes of simulation-based education. Level 1 (reactions) evaluates students' reaction to the training experience. Level 2 (learning) analyzes the learning outcomes (i.e., knowledge, skill, and attitude). Level 3 (behavior) focuses on the students' change in behavior (the learning transferred into practice). Level 4 (results) determines the final results (Heydari et al., 2019). In this study, we used Kirkpatrick's program evaluation model to evaluate the impact of simulation-based experience on nursing students' satisfaction, knowledge and skills, and their ability to transfer what they learned to the clinical setting. No study has yet evaluated the effect of moulage in simulation-based education according to Kirkpatrick's model. The aim of this study is to investigate the effectiveness of moulage in improving clinical skills of nursing students for the assessment of pressure injury for Level 1–3.

2. Methods

2.1. Research hypotheses

Five hypotheses were formed for this study according to Kirkpatrick's model:

I. The pressure injury assessment knowledge test scores of the students who were trained with moulage is higher than the students who were trained with wound visuals. (Level 2)
II. Pressure injury assessment performance scores of the students who were trained with moulage is higher than those who were trained with wound visuals in the laboratory setting. (Level 2)
III. Pressure injury assessment performance scores of the students who were trained with moulage is higher than those who were trained with wound visuals in the clinical setting. (Level 3)
IV. The level of satisfaction and self-confidence of students who trained with moulage is significantly higher than those who trained with wound visuals. (Level 1)
V. The simulation design scale scores of the students who trained with moulage is significantly higher than those who trained with wound visuals. (Level 1)

2.2. Design and participants

This study was conducted as a quasi-experimental study between October 2018 and August 2019. Simulation-based experiences were designed based on the Simulation INACSL Standards of Best Practice: Simulation^{SM} Simulation Design (INACSL, 2016). The scenarios were created using the simulation design template, and opinions were received using the content validity index from the simulation specialists in nursing education (Rutherford-Hemming, 2015; Waxman, 2010).

This study was conducted on fourth-year nursing students in a nursing faculty in Turkey ($n = 73$). The students who took the simulation elective course ($n = 38$) in the fall semester of the 2018–2019 academic year constituted the control group, and the students who took the course in the spring semester ($n = 35$) constituted the intervention group. The coin-flipping method was used to match the education period and student groups. While pressure injury visuals were used in the simulation practice of the students in the control group, moulage were used in the intervention group. A power analysis was carried out after the hypotheses with the Medicres *E*-PICOS program using the mean values and standard deviation of laboratory total performance scores of the groups (intervention group: 37.49 ± 7.56, control group: 31.47 ± 8.28). In the analysis, a power = 0.90 was measured for alpha = 0.05 and beta = 0.10.

2.3. Instruments

2.3.1. Student ID form

This form was developed by the researchers to define the students' age and gender characteristics.

2.3.2. Knowledge test for the assessment of pressure injury

The questionnaire was prepared by researchers based on the literature (Edsberg et al., 2016; Doughty and McNichol, 2016; Coleman et al., 2014). The knowledge test for the assessment of pressure injury consisted of 20 multiple-choice questions related to the pressure ulcer etiology (5 questions), classification system (6 questions), measurements (6 questions), and evaluation (3 questions). The highest score is 100, and the lowest score is 0. The test was presented to four experts. Two were stoma and wound care nurse, and remaining two were faculty members. These experts determined the validity of the questions. The content validity was analyzed as 0.81.

2.3.3. Performance checklist (for the researcher)

This form was prepared by researchers based on the literature (Dowsett, 2019; Doughty and McNichol, 2016). The same experts assessed the form. The form consisted of the stages of the pressure injury assessment and included eight items. The student's performance was scored as 'applied correctly' (3 points), 'applied incorrectly' (1 point), 'did not apply' (0 points), and 'misapplied' (0 points). Minimum and maximum scores were 0 and 24 points, respectively.

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

The scale was developed by Jeffries and Rizzolo (2006) as 13 items and was adapted to Turkish by Unver et al. (2017). Pursuant to the Turkish version of the scale, the total number of items is 12. This scale measures student self-confidence and satisfaction from learning in a simulation setting. The scale consists of two sub-dimensions, namely, "Satisfaction with current learning" and "Self-confidence in learning". The "Satisfaction with current learning" subtitle consists of 5 items, and the "Self-confidence in learning" subtitle consists of 7 items. Cronbach's alpha value was found to be 0.85 for "Satisfaction with Current Learning" and 0.77 for "Self-confidence in learning". Cronbach's alpha values in our study were found to be 0.95 for "Satisfaction with current learning" and 0.94 for "Self-confidence in learning". As the total score of the scale increases, student satisfaction and self-confidence in learning increases.

2.3.5. Simulation design scale (SD)

The SD scale was developed by Jeffries and Rizzolo (2006) and adapted to Turkish by Unver et al. (2017). The scale consists of 20 items and five sub-dimensions, including "objectives and information", "support", "problem solving", "guided reflection or feedback", and "fidelity". The first part of the scale, which is applied in two parts, contains expressions for the students' views on whether the best simulation design elements have been applied in the simulation. The second part of the scale was not used in the study. The increase in the total score obtained from the first part of the scale shows that the best simulation design elements were applied in the simulation (Jeffries and Rizzolo, 2006). Cronbach's alpha values for the first part sub-dimensions are 0.73. In our study, Cronbach's alpha value for the first part's sub-dimensions was determined as 0.74. Cronbach's alpha for the five sub-dimensions varied between 0.78 and 0.89.

2.3.6. Student feedback form for clinical practice

This semi-structured form consisted of three questions. The questions were "How did you feel when performing pressure injury assessment in clinical setting?", "Did you face any difficulty in performing pressure injury assessment for the first time on the patient?", and "How did your laboratory practice affect your pressure injury assessment in the clinical setting?". It was prepared by the researchers so that the students could express their feelings and thoughts about the ability to evaluate pressure injury on real patients in a clinical setting as well as the effects of the simulation on this process.

2.4. Procedures

This study was carried out in four stages to improve the pressure injury assessment skills of nursing students (Fig. 1).

Theoretical training consisted of the definition, epidemiology, prevalence, pathophysiology, risk assessment, staging, and evaluation of pressure injury being provided to all students using two-hour theoretical training, lecture, question and answer, and video demonstration teaching techniques.

Simulation practices consisted of the following. Before the simulation, the students were asked to answer the knowledge test about pressure injury assessment as a pre-test. In the intervention group, the researchers simulated Stage 2 or Stage 3 pressure injuries by using moulage techniques and materials on the trochanteric or lateral malleolar area of high-fidelity simulators. In the control group, one of the visuals of Stage 2, Stage 3, or Stage 4 pressure injury was attached to the sacral or trochanteric area of high-fidelity simulators. The simulation was started with pre-briefing, and each simulation practice lasted 10–15 min. The student's pressure injury assessment in the simulation practices was recorded with video. The students were divided into groups of two and taken into the simulation practice. A debriefing session was performed immediately after each simulation practice. The plus/delta approach was used for the debriefing session (Lavoie et al., 2017; Fanning and Gaba, 2007). This learned-centred approach provided self-assessment for the students. The facilitator asked the students "What did work in the simulation?" (plus) and "What could have been performed in a better way?" (delta) (Dusaj, 2014; Oriot and Alinier, 2018). Debriefing sessions lasted 20–30 min on average. Then, students were asked to fill out the "SSSC scale" and the "SD scale".

Performance assessment in laboratory setting was performed four weeks after the simulation. All students were evaluated individually by the same researcher and a "performance checklist" was used during the assessment. Laboratory assessment for each student lasted 10–15 min. Similar to the simulation practice, the stage 3 pressure injury was simulated by applying moulage techniques to the lateral malleolus of the simulator in the experimental group, whereas in the control group, the visual of stage 3 pressure injury was affixed to the simulator. In addition, the student's pressure injury assessment was recorded by video. When they finished the laboratory performance assessment, the students' questions were answered, and feedback was given to the students. The knowledge test for the assessment of pressure injuries was reapplied as a post-test to the students who completed this stage.

Performance assessment in the clinical setting was performed two weeks after the assessment in the laboratory setting. Clinical practice was carried out under the supervision of a wound care nurse, and the students did not perform any treatment or care for the wound. Not all students who participated in the study could be included in the performance assessment in clinical settings. This stage was performed with 20 students from the control group and 22 students from the experimental group. The stoma and wound care nurse selected the appropriate patients, and then the researcher planned the hours for the students accordingly. Each student participated in the performance assessment singly, and the students were able to perform the clinical performance once. Performance assessment in the clinical setting was performed by a stoma and wound care nurse who was also a member of the hospital staff as well as a student and researcher. After the practice, the students' questions were answered, and feedback was given to the students. Each student was asked to fill out the "Feedback form for clinical practice" immediately after the performance assessment in the clinical setting.

2.5. Ethical considerations

Ethics committee approval was received from XXXX Committee (with 18/228 registration number, in September 2018). Before starting the study, permission was obtained from the nursing faculty where the research was conducted. The purpose and method of the study were explained to the students, and students who voluntarily agreed to participate in the study were included in the study. Written informed consent was obtained to participate in the study. During the study, the students were informed that pressure injury assessment practices in laboratory and clinical settings will not affect the ability to pass the course and that these scores will only be used as data. They were also instructed that they could leave the study at any time.

2.6. Data analysis

We used SPSS version 16.0 (SPSS Inc., Chicago, IL) to conduct the statistical analysis. The level of significance was set at 0.05 for all tests. The normality of the data was tested using the Kolmogorov–Smirnov and Shapiro-Wilk tests. The descriptive statistics were presented using the arithmetic mean and standard deviation as well as

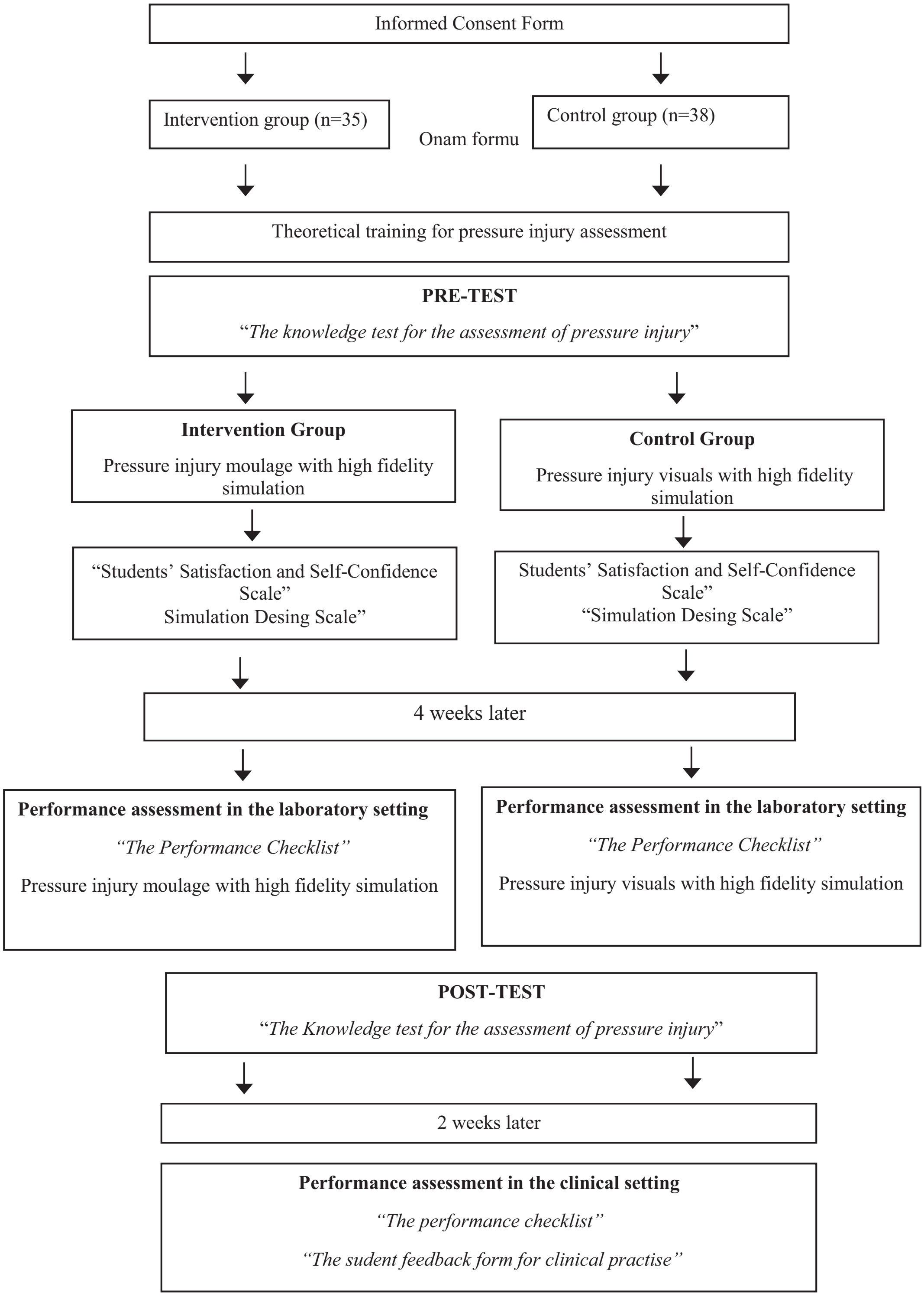


Fig. 1. Flow diagram.

minimum–maximum, frequency, and percentage values. The results obtained were compared using the paired *t*-test, Student t-test, Chi-square, Mann Whitney *U* test, and Wilcoxon test.

A content analysis method was used to analyze the qualitative data obtained from the student feedback form for clinical practice. In the content analysis using a manifest style, four stages were followed as the decontextualisation, the recontextualisation, the categorisation, and the compilation (Bengtsson, 2016).

3. Results

3.1. Sociodemographic characteristics

The mean age of the students in the control group was 21.16 ± 0.06, and the mean age of the students in the intervention group was 21.14 ± 0.06. There was no statistically significant difference between the mean ages of the groups (t = 0.17, p = 0.86). While 92.1% (n = 35) of the students in the control group were female, 7.9%

Table 1
Comparisons of pre-test and post-test knowledge scores in the control and intervention groups (n = 73).

	Pre-test M ± SD (Min-Max)	Post-test M ± SD (Min-Max)	p
Intervention group (n = 35)	61.71 ± 9.77 (45–85)	70.57 ± 12.53 (55–100)	< **0.001**[a]
Control group (n = 38)	66.81 ± 13.47 (40–85)	73.06 ± 15.50 (35–100)	**0.02**[a]
p	0.07[b]	0.46[b]	

Bold data indicates statistically significant at p < 0.05.
[a] Paired t-test.
[b] Student t-test.

(n = 3) were male, and 100% (n = 35) of the students in the intervention group was female. There was no statistically significant difference between the two groups in terms of gender distributions (p = 0.24).

3.2. Knowledge acquisition

Table 1 presents the pre-test and post-test knowledge scores of the students in the intervention and control groups for the assessment of pressure injury. There was a statistically significant difference between the pre-test and post-test knowledge scores in both groups ($t = -4.27$, $p < 0.001$; $t = -2.34$, $p = 0.02$). When the knowledge post-test mean scores of the groups for the pressure injury assessment were compared, no statistically significant difference ($t = -0.74$, $p = 0.46$) was observed.

3.3. Skills acquisition

Table 2 shows a comparison of the median laboratory and clinical practice performance scores of pressure injury assessment for the intervention (n = 22) and control (n = 20) students. The mean score of the pressure injury assessment performance of the students in the intervention group was 16.00 (IQR = 3), and the mean value of the students in the control group was 11.50 (IQR = 5). The difference between the performance score medians of the groups is statistically significant (Z = −4.13, p < 0.001).

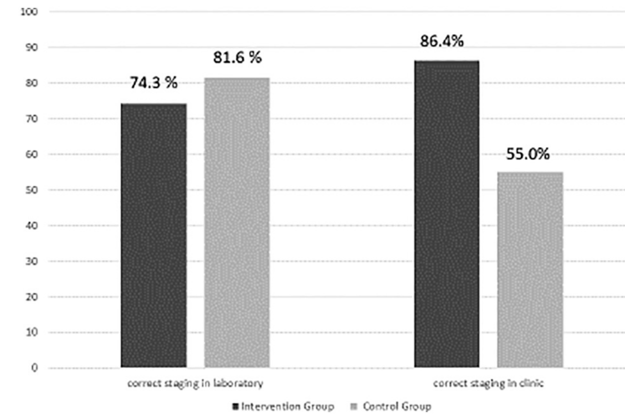
No statistically significant difference was found between the laboratory pressure injury assessment performance median value and the clinical pressure injury assessment performance median value between the students in the intervention group and the control group (Z = −0.39, p = 0.69; Z = −1.11, p = 0.26).

As can be seen in Graph 1, no statistically significant difference was found in terms of the distribution of the groups according to the correct staging of pressure injury ($\chi2 = 0.56$, $p = 0.45$) in the laboratory

Table 2
Comparison of performance scores in control and intervention groups (n = 42).

Pressure ulcer assessment	Intervention group (n = 22) Median (IQR) (Min-Max)	Control group (n = 20) Median (IQR) (Min-Max)	p
Performance assessment in laboratory setting	16.00(4) (8.00–18.00)	13.00(2) (5.00–16.00)	**0.001**[a]
Performance assessment in clinical setting	16.00(3) (12.00–18.00)	11.50(5) (7.00–16.00)	< **0.001**
p	0.69[b]	0.26	

[a] Mann Whitney U test.
[b] Wilcoxon test.



Graph 1. The correct staging percentages of the control and intervention groups (n = 42).

assessment phase. In the clinical evaluation phase, 55% (n = 11) of the students in the control group assessed the stage correctly, and 45% (n = 9) mis-staged, while 86.4% (n = 19) of the students in the intervention group assessed correctly, and 14.6% (n = 3) mis-staged. The intervention group was found to be statistically significantly more successful than the control group students in terms of correct staging distribution of pressure injury in the clinic ($\chi2 = 5.05$, $p = 0.02$).

3.4. SSSC and SD

Table 3 shows the SD and SSSC mean scores of the students in the intervention and control groups. There was no statistically significant difference in the mean scores of the "Student Satisfaction in Learning" and "Self-confidence in Learning" sub-scales ($t = 1.03$, $p = 0.30$; $t = 1.65$, $p = 0.10$). When the mean scores of the SD scale between the students in the intervention and control groups were examined, a statistically significant difference was found between the total score means for the "Best Design Elements" part ($t = 2.00$, $p = 0.04$).

3.5. Clinical experience feedbacks

Three themes were created by the authors. The themes included difficulties, positive feedback, and negative feedback. 80% of the students who were trained in the control group and 77% of those in the intervention group stated that they had no difficulty in assessing pressure injuries during clinical practice. Among the students who stated that they had difficulty, the ones in the intervention group gave feedbacks such as "... I was scared since it was something I had never seen before". Example feedback from the control group was "I could not differentiate tissue, bone, tendon visuals..." and "I had difficulty in remembering the terms..."

Positive feedback was received from the students to the question of how wound identification by moulage and wound visuals during laboratory training affected their diagnostic skills on real patients. The students stated that the simulation supported the integration of theory and practice and that they felt confident in clinical settings under the theme of positive feedback. However, the students in the intervention group found the simulations of diagnosing pressure injuries more realistic. Some of the students expressed this as follows:

> "... the staging was easy for me, it was good for me to work on the moulage beforehand."

> "Touching and communicating with a real patient is different, of course, but I felt less stressed in the simulation. Simulations are also very close to the real experience; only it was more difficult to communicate with the real patient."

> "Pre-defining on the moulage made it visually a lot easier and more

Table 3
Comparisons of Students'Satisfaction and Self-Confidence Scale and Simulation Design Scale scores in the control and intervention groups (n = 73).

	Intervention group(n = 35) M ± SD	Control group(n = 38) M ± SD	p[a]
Student' satisfaction and self-confidence scale	4.40 ± 0.72	4.17 ± 0.77	0.19
-Student satisfaction in learning	4.52 ± 0.74	4.34 ± 0.78	0.30
-Self-confidence in learning	4.32 ± 0.74	4.02 ± 0.79	0.10
Simulation desing scale	4.54 ± 0.44	4.33 ± 0.45	**0.04**
-Objectives and information	4.55 ± 0.50	4.31 ± 0.56	0.06
-Support	4.25 ± 0.58	4.04 ± 0.52	0.10
-Problem solving	4.68 ± 0.50	4.54 ± 0.60	0.07
-Feedback/guided reflection	4.63 ± 0.66	4.47 ± 0.53	0.27
-Fidelity	4.69 ± 0.46	4.33 ± 0.51	**0.003**

Bold data indicates statistically significant at $p < 0.05$.
[a] Paired t-test.

memorable."

"I think that wound moulage simulation is also realistic. I realized that the simulation was educative in terms of assessing the real patient."

"I didn't have much difficulty in doing this since I had practiced in the simulation before, my skills improved."

4. Discussion

Simulation specialists in nursing education have suggested that studies are needed to determine how well simulation-based education prepares nursing students for actual clinical practice (Bryant et al., 2020). Hustad et al. (2019) emphasized that the organization of simulation-based education is important for nursing students' experiences of the transfer of knowledge to clinical practice. The aim of this study was therefore to investigate the effectiveness of moulage in improving clinical skills of nursing students for the assessment of pressure injury according to Kirkpatrick's model (levels 1–3).

4.1. Knowledge acquisition

The results of our study showed that both moulage and wound visuals used in high-fidelity simulators were effective in improving the pressure injury assessment knowledge level of undergraduate nursing students. There are many pre-test and post-test studies that have shown that simulations performed at different levels of fidelity increase participants' knowledge levels (Scholtz et al., 2013; Crowe et al., 2018; Kunst et al., 2017; Heinrich et al., 2012). The findings of our study are similar to the previous studies in terms of cognitive knowledge acquisition.

In the results of our study, we found no difference in terms of knowledge acquisition between training by moulage and wound visuals for the assessment of pressure injury. Levett-Jones et al. (2011) used medium- and high-fidelity simulation to evaluate the effect of the fidelity level of simulation on nursing students' knowledge acquisition and did not find a significant difference between the knowledge levels of the students in either of the groups after the practice (Levett-Jones et al., 2011). Silva et al. (2020) compared the trainings for wound treatment and evaluation using moulage with interactive trainings, and they similarly found that cognitive knowledge increased in both groups but that there was no difference between the groups (Silva et al., 2020).

4.2. Skills acquisition

The laboratory and clinical pressure injury assessment skill scores of the students who were educated with the moulage were found to be higher than the wound visuals group. In addition, the percentage of correct staging of the students who were trained with moulage during the clinical evaluation stage was higher than the students who were trained with wound visuals. These findings suggest that the trainings based on high-fidelity simulations including the moulage were more successful in transferring the skills acquired in the laboratory to clinical practice than the trainings using wound visuals. The positive feedback regarding clinical practice from the students who received training based on simulation with the moulage also supports this finding. The literature has stated that having experiences with high-fidelity simulation prepares students for clinical settings and offers them permanent and conscious learning opportunities (Kirkman, 2013; Domuracki et al., 2009; Kunst et al., 2017).

Although there are many studies comparing simulation with classical methods, there are few studies examining the effect of different levels of fidelity on knowledge and skill acquisition in pressure injury assessment training. Mills et al. (2018) used the moulage in a trauma simulation to train one group of paramedic students, while the other group was trained without moulage. In the study, no significant difference was found between the skill scores of the students (Mills et al., 2018). However, students stated that the addition of three dimensions to the simulation with the moulage provided a valuable opportunity for practical experience that had not previously been provided to them in standard classroom settings. Garg et al. (2010) stated that as a result of the interaction created by the moulage, it provides a higher level of remembrance in students. The reality augmented with moulage is a result that reduces the cognitive burden of participants and enables them to establish a better relationship (Stokes-Parish et al., 2019).

4.3. SSSC and SD

In our study, the SD scale mean scores of the students who were educated with the moulage were found to be higher than those of the students who were trained with wound visuals. In studies comparing low- and high-fidelity simulation in terms of SD scale scores, the scores of high fidelity were found to be similarly higher (Basak et al., 2018; Butler et al., 2009). Wang et al. (2013) found that the students in the high-fidelity simulation group had higher SD scale mean scores in their study conducted using medium and high-fidelity simulators. In our study, the fact that the SD scale scores of the students who participated in the simulation conducted with the moulage were significantly higher was associated with the fact that these wounds were more realistic and the student interaction was higher.

Although research has demonstrated that SSSC scores of students receiving higher fidelity training are higher, we found that there was no difference between the SSSC scale mean scores of both student groups in our research (Basak et al., 2016; Wang et al., 2013; Arnold et al., 2013; Butler et al., 2009). The fourth-year students who constituted the sample of our study participated in simulation-based training for the first time. It was determined that the students in both groups showed a similar level of SSSC score towards this teaching method, which they experienced for the first time. This makes our study different from the literature in terms of satisfaction and self-confidence scores. The effect of the concept of fidelity on simulation-based trainings is still an open research subject, and some studies emphasize that the relationship between fidelity and learning is not one-dimensional and linear (Kim et al., 2016; Norman et al., 2012).

5. Limitations

The study was conducted in a single center and only with fourth-year students. In addition, students' pressure injury performance assessment was evaluated only once in the laboratory and on a real patient.

6. Conclusions

As a result of this study, it was determined that in the trainings for the assessment of pressure injury, both the group using moulage and the group using pressure injury visuals increased their knowledge acquisition. Compared to the students who were trained with pressure injury visuals in the control group of students who were trained with moulage in the intervention group, moulage was found to be more effective in developing assessment skills compared to wound visuals. Also, it was found that the moulage was more effective than wound visuals when transferring skills to clinical practice. At the same time, the students who trained with moulage were more successful in correctly staging the pressure injury when making an evaluation on a real patient for the first time. Further studies should be conducted of the effects of moulage used in simulation-based trainings on the acquisition of different skills.

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

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Acknowledgements

The authors wish to thank all the participating nursing students.

Funding

This study was founded by University of Health Sciences Turkey, Scientific Research Projects (No:2018/097).

References

Anthony, D., Alosoumi, D., & Safari, R. (2019). Prevalence of pressure ulcers in long-term care: a global review. Journal of Wound Care, 28(11), 702–709. doi:10.12968/jowc.2019.28.11.702.

Arnold, J.J., Johnson, L.M., Tucker, S.J., Chesak, S.S., Dierkhising, R.A., 2013. Comparison of three simulation-based teaching methodologies for emergency response. Clinical Simulation in Nursing 9 (3), e85–e93. https://doi.org/10.1016/j.ecns.2011.09.004.

Barakat-Johnson, M., Lai, M., Barnett, C., Wand, T., Lidia Wolak, D., Chan, C., ... White, K., 2018. Hospital-acquired pressure injuries: Are they accurately reported? A prospective descriptive study in a large tertiary hospital in Australia. Journal of Tissue Viability. https://doi.org/10.1016/j.jtv.2018.07.003.

Basak, T., Unver, V., Moss, J., Watts, P., Gaioso, V., 2016. Beginning and advanced students' perceptions of the use of low- and high-fidelity mannequins in nursing simulation. Nurse Educ. Today 36, 37–43. https://doi.org/10.1016/j.nedt.2015.07.020.

Basak, T., Aciksoz, S., Unver, V., Aslan, O., 2018. Using standardized patients to improve the hygiene care skills of first-year nursing students: a randomized controlled trial. Collegian 26 (1), 49–54. https://doi.org/10.1016/j.colegn.2018.03.005.

Bengtsson, M., 2016. How to plan and perform a qualitative study using content analysis. NursingPlus Open 2, 8–14. https://doi.org/10.1016/j.npls.2016.01.001.

Bruce, T.A., Shever, L.L., Tschannen, D., Gombert, J., 2012. Reliability of pressure ulcer staging. Crit. Care Nurs. Q. 35 (1), 85–101. https://doi.org/10.1097/cnq.0b013e31823b1f22.

Bryant, K., Aebersold, M.L., Jeffries, P.R., Kardong-Edgren, S., 2020. Innovations in simulation: nursing leaders' exchange of best practices. Clinical Simulation in Nursing 41 (C), 33–40. https://doi.org/10.1016/j.ecns.2019.09.002.

Butler, K.W., Veltre, D.E., Brady, D., 2009. Implementation of active learning pedagogy comparing low-fidelity simulation versus high-fidelity simulation in pediatric nursing education. Clinical Simulation in Nursing 5 (4), e129–e136. https://doi.org/10.1016/j.ecns.2009.03.118.

Coleman, S., Nixon, J., Keen, J., Wilson, L., McGinnis, E., Dealey, C., Stubbs, N., Farrin, A., Dowding, D., Schols, J.M.G.A., Cuddigan, J., Berlowitz, D., Jude, E., Vowden, P., Schoonhoven, L., Bader, D.L., Gefen, A., Oomens, C.W.J., Nelson, E.A., 2014. A new pressure ulcer conceptual framework. J. Adv. Nurs. 70 (10), 2222–2234. https://doi.org/10.1111/jan.12405.

Crowe, S., Ewart, L., Derman, S., 2018. The impact of simulation based education on nursing confidence, knowledge and patient outcomes on general medicine units. Nurse Educ. Pract. 29, 70–75. https://doi.org/10.1016/j.nepr.2017.11.017.

Domuracki, K.J., Moule, C.J., Owen, H., Kostandoff, G., Plummer, J.L., 2009. Learning on a simulator does transfer to clinical practice. Resuscitation 80 (3), 346–349. https://doi.org/10.1016/j.resuscitation.2008.10.036.

Doughty, D., McNichol, L. (Eds.), 2016. Wound Ostomy and Continence Nurses Society Core Curriculum: Wound Management. Wolters-Kluwer.

Dowsett, C. (2019). T.I.M.E. to improve patient outcomes: use of a clinical decision support tool to optimise wound care. British Journal of Community Nursing, 24(Sup3), S6–S11. doi:10.12968/bjcn.2019.24.sup3.s6.

Durmaz Edeer, A., Sarıkaya, A. (2015). The use of simulation in nursing education and simulation types. Koç University Journal of Nursing Education and Research,12(2), 121–125. doi:https://doi.org/10.5222/HEAD.2015.121.

Dusaj, T.K., 2014. Five fast fixes: debriefing. Clinical Simulation in Nursing 10 (9), 485–486. https://doi.org/10.1016/j.ecns.2014.06.002.

Edsberg, L.E., Black, J.M., Goldberg, M., McNichol, L., Moore, L., Sieggreen, M., 2016. Revised National Pressure Ulcer Advisory Panel pressure injury staging system. Journal of Wound, Ostomy and Continence Nursing 43 (6), 585–597. https://doi.org/10.1097/won.0000000000000281.

Edwards, S., McCormack, S., 2018. Simulation using "live" adult service users and moulage in a variety of settings. Nurs. Manag. 24 (9), 33–40. https://doi.org/10.7748/nm.2018.e1674.

Fanning, R.M., Gaba, D.M., 2007. The role of debriefing in simulation-based learning. Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare 2 (2), 115–125. https://doi.org/10.1097/sih.0b013e3180315539.

Garg, A., Haley, H.-L., Hatem, D., 2010. Modern moulage. Arch. Dermatol. 146 (2). https://doi.org/10.1001/archdermatol.2009.355.

Heinrich, C., Pennington, R.R., Kuiper, R., 2012. Virtual case studies in the classroom improve student knowledge. Clinical Simulation in Nursing 8 (8), e353–e361. https://doi.org/10.1016/j.ecns.2011.02.002.

Hernandez, C., Mermelstein, R., Robinson, J.K., Yudkowsky, R., 2013. Assessing students' ability to detect melanomas using standardized patients and moulage. J. Am. Acad. Dermatol. 68 (3), e83–e88. https://doi.org/10.1016/j.jaad.2011.10.032.

Heydari, M.R., Taghva, F., Amini, M., Delavari, S., 2019. Using Kirkpatrick's model to measure the efect of a new teaching and learning methods workshop for health care staff. BMC Res Notes 12, 388. https://doi.org/10.1186/s13104-019-4421-y.

Hustad, J., Johannesen, B., Fossum, M., Hovland, O.J., 2019. Nursing students' transfer of learning outcomes from simulation-based training to clinical practice: a focus-group study. BMC Nurs. 18 (1). https://doi.org/10.1186/s12912-019-0376-5.

INACSL Standards Committee (2016, December). INACSL standards of best practice: Simulation[SM] Simulation design. Clinical Simulation in Nursing, 12(S), S5–S12. https://doi.org/10.1016/j.ecns.2016.09.005.

Jeffries, P.R., Rizzolo, M.A., 2006. Designing and Implementing Models for the Innovative Use of Using Simulation to Teach Nursing Care of Ill Adults and Children: A National, Multi-site, Multi-method Study. National League for Nursing, New York, NY.

Kim, J., Park, J.-H., Shin, S., 2016. Effectiveness of simulation-based nursing education depending on fidelity: a meta-analysis. BMC Medical Education 16 (1). https://doi.org/10.1186/s12909-016-0672-7.

Kirkman, T.R., 2013. High fidelity simulation effectiveness in nursing students' transfer of learning. Int. J. Nurs. Educ. Scholarsh. 10 (1). https://doi.org/10.1515/ijnes-2012-0009.

Kunst, E.L., Mitchell, M., Johnston, A.N.B., 2017. Using simulation to improve the capability of undergraduate nursing students in mental health care. Nurse Educ. Today 50, 29–35. https://doi.org/10.1016/j.nedt.2016.12.012.

Labrague, L.J., McEnroe-Petitte, D.M., Bowling, A.M., Nwafor, C.E., Tsaras, K., 2019. High-fidelity simulation and nursing students' anxiety and self-confidence: a systematic review. Nurs. Forum. https://doi.org/10.1111/nuf.12337.

Lavoie, P., Pepin, J., Cossette, S., 2017. Contribution of a reflective debriefing to nursing students' clinical judgment in patient deterioration simulations: a mixed-methods study. Nurse Educ. Today 50, 51–56. https://doi.org/10.1016/j.nedt.2016.12.002.

Levett-Jones, T., Lapkin, S., Hoffman, K., Arthur, C., Roche, J., 2011. Examining the impact of high and medium fidelity simulation experiences on nursing students' knowledge acquisition. Nurse Educ. Pract. 11 (6), 380–383. https://doi.org/10.1016/j.nepr.2011.03.014.

MacLean, S., Kelly, M., Geddes, F., Della, P., 2017. Use of simulated patients to develop communication skills in nursing education: an integrative review. Nurse Educ. Today 48, 90–98. https://doi.org/10.1016/j.nedt.2016.09.018.

Mazzo, A., Miranda, F.B.G., Meska, M.H.G., Bianchini, A., Bernardes, R.M., Pereira Junior, G.A., 2017. Teaching of pressure injury prevention and treatment using simulation. Escola Anna Nery 22 (1). https://doi.org/10.1590/2177-9465-ean-2017-0182.
Mills, B.W., Miles, A.K., Phan, T., Dykstra, P.M.C., Hansen, S.S., Walsh, A.S., Reid, D.N., Langdon, C., 2018. Investigating the extent realistic moulage impacts on immersion and performance among undergraduate paramedicine students in a simulation-based trauma scenario. Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare 1. https://doi.org/10.1097/sih.0000000000000318.
Moule, P., 2011. Simulation in nurse education: past, present and future. Nurse Educ. Today. https://doi.org/10.1016/j.nedt.2011.04.005.
National League for Nursing (NLN). Core competencies of nurse educators with task statements, competency 1 – facilitate learning. 2005. http://www.nln.org/professional-development-programs/simulation (Accessed 20.01.2019).
National pressure ulcer advisory panel, 2014. European Pressure Ulcer Advisory Panel, and Pan Pacific Pressure Injury Alliance, Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline. Cambridge Media, Osborne Park, Western Australia.
Norman, G., Dore, K., Grierson, L., 2012. The minimal relationship between simulation fidelity and transfer of learning. Med. Educ. 46 (7), 636–647. https://doi.org/10.1111/j.1365-2923.2012.04243.x.
Oriot, D., Alinier, G. (2018). Pocket Book for Simulation Debriefing in Healthcare. Springer. p.35–56. https://doi.org/10.1007/978-3-319-59882-6.
Rutherford-Hemming, T., 2015. Determining content validity and reporting a content validity index for simulation scenarios. Nurs. Educ. Perspect. 36 (6), 389–393.
Samuriwo, R., Dowding, D., 2014. Nurses' pressure ulcer related judgements and decisions in clinical practice: A systematic review. Int. J. Nurs. Stud. 51 (12), 1667–1685. https://doi.org/10.1016/j.ijnurstu.2014.04.009.
Scholtz, A.K., Monachino, A.M., Nishisaki, A., Nadkarni, V.M., Lengetti, E., 2013. Central venous catheter dress rehearsals. Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare 8 (5), 341–349. https://doi.org/10.1097/sih.0b013e3182974462.
Silva, J.L.G., Kumakura, Oliveira, de S., A.R., Zanchetta, F.C., Dias Coutinho, V.R., Lima, M.H.M., 2020. Clinical simulation for teaching of wound evaluation and treatment. Clinical Simulation in Nursing 38, 5–13. https://doi.org/10.1016/j.ecns.2019.09.003.
Smith-Stoner, M., 2011. Using moulage to enhance educational instruction. Nurse Educ. 36 (1), 21–24. https://doi.org/10.1097/nne.0b013e3182001e98.
Spear, M., 2013. Pressure ulcer staging—revisited. Plast. Surg. Nurs. 33 (4), 192–194. https://doi.org/10.1097/psn.0000000000000015.
Stokes-Parish, J., Duvivier, R., Jolly, B., 2019. Expert opinions on the authenticity of moulage in simulation: a Delphi study. Adv. Simul. 4 (1). https://doi.org/10.1186/s41077-019-0103-z.
The NCSBN National Simulation Study, 2014. A longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. Journal of Nursing Regulation 5 (2), S3–S40. https://doi.org/10.1016/s2155-8256(15)30062-4.
Unver, V., Basak, T., Watts, P., Gaioso, V., Moss, J., Tastan, S., Iyigun, E., Tosun, N., 2017. The reliability and validity of three questionnaires: the student satisfaction and self-confidence in learning scale, simulation design scale, and educational practices questionnaire. Contemp. Nurse 53 (1), 60–74. https://doi.org/10.1080/10376178.2017.1282319.
Wang, A.L., Fitzpatrick, J.J., Petrini, M.A., 2013. Comparison of two simulation methods on Chinese BSN students' learning. Clinical Simulation in Nursing 9 (6), e207–e212. https://doi.org/10.1016/j.ecns.2012.01.007.
Waxman, K.T., 2010. The development of evidence-based clinical simulation scenarios: guidelines for nurse educators. J. Nurs. Educ. 49 (1), 29–35.
Woodruff, K., O'Neill, S.P., Walton-Moss, B.J., 2017. Exploring APN students' perceptions, self-confidence, and satisfaction with clinical simulation. Nurs. Educ. Perspect. 38 (6), 347–349. https://doi.org/10.1097/01.nep.0000000000000176.
World Health Organization, 2009. Global Status Report on Road Safety: Time for Action. World Health Organization [Internet]. [cited 2018 Febr 27]. Available from. www.who.int/hrh/nursing_midwifery/en/.
Yuan, H.B., Williams, B.A., Fang, J.B., Ye, Q.H., 2012. A systematic review of selected evidence on improving knowledge and skills through high-fidelity simulation. Nurse Educ. Today 32 (3), 294–298. https://doi.org/10.1016/j.nedt.2011.07.010.