Araştırma makalesi
Research article

Evaluation of the Effectiveness of Different Simulators in Developing Urethral Catheterization Skills in Nursing Students

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ABSTRACT

Aim: The aim of this study was to evaluate the effectiveness of different simulators for the development of students' urethral catheterization skills.

Material and Methods: This study was conducted using a quasi-experimental design with 2nd year nursing students (n=80) at a nursing school in the Aegean Region of Turkey between November and December of 2018. This study was approved by the ethics committee of a university (Approval Number: 2016-273). Students were randomly assigned to three groups (partial urethral catheterization simulator, whole-body simulator, or partial urethral catheterization simulator with poster). All participants were evaluated through a hybrid simulation method. The data were analyzed using the Chi-square test, Wilcoxon Signed-Rank test, and Kruskal-Wallis test.

Results: As a result of this study, it was shown that while the knowledge levels of the students did significantly increase in all groups (p<0.05), the performance scores of the students significantly increased only in the partial urethral catheterization simulator with the poster group (p<0.05).

Conclusions: The use of a partial urethral catheterization simulator with poster did significantly develop the urethral catheterization skills of the nursing students.

Keywords: Nursing students, simulation, urethral catheterization

ÖZ

Hemşirelik Öğrencilerinde Üriner Kateterizasyon Uygulama Becerisi Geliştirmede Farklı Simülatörlerin Etkinliğinin Değerlendirilmesi

Amaç: Bu çalışmanın amacı, öğrencilerin üriner kateterizasyon becerilerinin gelişimi için farklı simülatörlerin etkinliğini değerlendirmektir.

Gereç ve Yöntem: Bu çalışma, Kasım ve Aralık 2018 tarihleri arasında Türkiye'nin Ege Bölgesi'nde bir hemşirelik okulunda 2. sınıf hemşirelik öğrencileriyle (n=80) yarı deneysel desen kullanılarak yürütülmüştür. Bu çalışma bir üniversitenin etik kurulu tarafından onaylanmıştır (Onay Numarası: 2016-273). Öğrenciler randomize edilerek üç gruba (parça üriner kateterizasyon simülatörü, tüm vücut simülatörü, ya da posterli parça üriner kateterizasyon simülatörü) ayrılmıştır. Tüm katılımcı hemşirelik öğrencileri hibrid simülasyon yöntemi ile değerlendirilmiştir. Veriler, Ki Kare testi, Wilcoxon İşaretli Sıralar testi ve Kruskal-Wallis testi kullanılarak analiz edilmiştir.

Bulgular: Bu çalışmanın sonucunda, öğrencilerin bilgi düzeylerinin tüm simülatör gruplarında anlamlı olarak artarken (p<0.05), sadece posterli parça üriner kateterizasyon simülatörü ile uygulama yapan öğrencilerin performans puanlarının anlamlı olarak arttığı gösterilmiştir (p<0.05).

Sonuç: Posterli parça üriner kateterizasyon simülatörü kullanılması, katılımcı hemşirelik öğrencilerinin üriner kateterizasyon becerilerini önemli ölçüde geliştirmiştir.

Anahtar kelimeler: Hemşirelik öğrencisi, simülasyon, üriner kateterizasyon

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INTRODUCTION

Essential problems remain in transferring theoretical knowledge to nursing students within the clinical practice educational learning environment[1]. Recently, to reduce the gap between theoretical knowledge and clinical practice, simulation-based experience (SBE) in nursing education has become increasingly widespread[2]. Before clinical practices, the use of simulation in nursing education aids in developing students' technical and non-technical skills (problem-solving, critical thinking, decision making, etc.), as well as provides them with realistic experiences that better prepare them when clinic practices begin[3,4]. Some advantages of SBE include immediate feedback, repetitive practice, student-level practice, and the opportunity for students to develop important non-technical skills such as critical thinking and clinical decision making[5].

The concept of fidelity is vital in simulation-based education, yet the relationship between the level of fidelity of simulators and learning outcomes remains open to debate. It is argued that the use of low-fidelity simulators has been shown to reduce costs without compromising learning outcomes[3]. In addition, some studies indicate high-fidelity simulators can be used to enrich the learning experiences of nursing students[6-9]. It is believed that an essential criterion for deciding which type of simulation modality is best for use is the ultimate learning outcomes[10]. Kim et al. (2016) carried out a meta-analysis to analyze the effects of simulator fidelity and conclude that although SBE is particularly influential in developing students' technical and non-technical skills, it is not proportional to the level of fidelity. Therefore, it is emphasized that using a suitable fidelity of simulation to achieve the desired learning outcomes is important[5].

The primary focus of clinical education in nursing is to develop students' knowledge, skills, attitudes, and critical thinking as well as to facilitate accurate clinical decision-making. However, the complexity of health care systems makes it difficult for nursing students to receive proper clinical practices for gaining the required competencies. Although learning by doing is essential for nursing students to develop requisite knowledge and skills, developing these skills with actual patients within clinical settings is not appropriate for patient safety[2,11]. In addition, there are often limited opportunities for nursing students to practice some basic skills with real patients. One of the basic skills that nursing students must learn is the practice of inserting a urethral catheter. It is reported though, that in clinical settings, patients are less comfortable when urethral catheterization (UC) is performed by students[10]. Therefore, nursing students must develop adequate UC skills before their actual clinical practices begin. There are various simulator types on the market used to teach these skills. However, nursing educators must choose the most suitable simulators for achieving desired UC implementation learning outcomes. To the best of our knowledge, there is no study evaluating the effectiveness of different simulators regarding UC implementation.

Aim

This study aimed to evaluate the effectiveness of different simulators for developing nursing students' urethral catheterization skills during UC skills training.

MATERIAL and METHODS

Study Design

This study was designed as a quasi-experimental study and carried out between November and December of 2018. This study was designed, conducted, and analyzed according to the standards set forth by the International Nursing Association for Clinical Simulation and Learning Standards Committee (INACSL)[12].

Study Sample

This study was conducted with 2nd year nursing students (n=277) at a nursing school in the Aegean region of Turkey. Inclusion criteria for students in this study were: (1) voluntary acceptance of study participation, (2) having no clinical experience, and (3) previously participated in theoretical and practical teaching regarding urinary elimination, which includes education on urethral catheter insertion.

Eighty-eight students who met the study inclusion criteria were included in the study population. These 88 students were randomly allocated into groups via a computer program (http://www.randomizer.org). There were students from 3 success levels [low grade (60-73), medium grade (74-87), and high grade (88-100)], which were grouped according to their weighted grade point average. In Group 1 (whole-body simulator, Nasco), there were 29 students; in group 2 (partial UC simulator with poster, Lifeform), there were 30 students, and in group 3 (partial UC simulator, Lifeform), there were 29 students. Due to various reasons, three students from group 1, two from group 2, and three from group 3 were ultimately excluded from the study. As a result, a total of 80 students were included in the final study population (Figure 1).

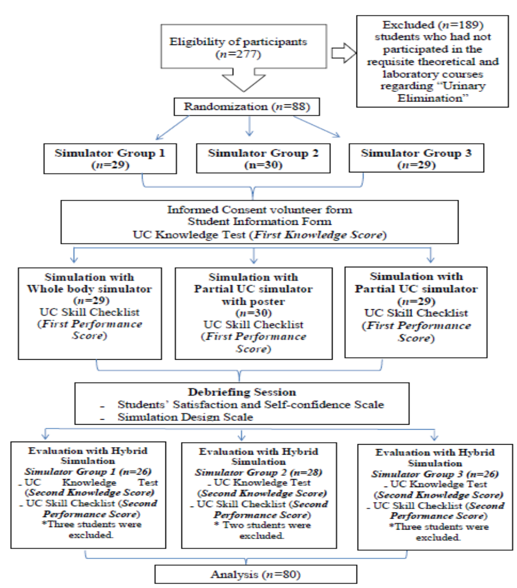

Figure 1. Flow diagram of the study

Training Standardized Patient

Two standardized patients (SPs) trained by the Medical Education Department of the Faculty of Medicine enrolled in the study. To ensure consistency, SPs were brought together in the simulation laboratory of the school of nursing a day before the simulation and were provided with detailed information regarding the scenario, including the roles and responsibilities they were required to carry out within the scenario. In addition, the study was piloted with all SPs a day before the simulation activity.

Data Collection Tools

Data for the current study were collected utilizing the Student Information Form, UC Knowledge Test, UC Skill Checklist, Students' Satisfaction and Self-confidence Scale, and Simulation Design Scale.

Student Information Form

The author developed this form to determine participants' demographic characteristics.

UC Knowledge Test

The author developed this test based on the literature and included a total of 16 multiple-choice questions.[13,14] While the UC Knowledge Test questions were being developed, the opinions of three nurse educator experts working at different universities were obtained. The lowest possible score was 0, and the maximum score possible was 16. This test was administered to all participants before the outset of the study and following the skill performance assessment.

UC Skill Checklist

The checklist was developed by the authors based on the literature.[13-15] While the checklists were being developed, the opinions of three nurse educator experts working at different universities were obtained. In addition, a pilot study was performed with five students not included in this current study. The prepared checklist consisted of 22 steps regarding UC implementation, and each step was evaluated based on a scale of 0 to 3, with 0 being not performed, 1 insufficient/weak, 2 moderate, and 3 good. The maximum score possible was 66, and the lowest was 0. Higher scores indicated that students have higher skill levels in urethral catheter practice. The first and second performance scores from students' UC practice were obtained using this checklist.

Students' Satisfaction and Self-confidence Scale (SSSC)

The original scale used as a reference consisted of thirteen items developed by Jeffries and Rizzolo (2006)[16]. The adaptation of this scale to Turkish was carried out by Unver et al. (2017)[17]. The Turkish version of the SSSC consists of twelve items and a total Cronbach alpha value of 0.89. Higher scores indicate a higher level of satisfaction and self-confidence of students. The scale includes the subcategories of "satisfaction with current learning" and "self-confidence in learning"[17].

Simulation Design Scale (SDS)

The original scale was also developed by Jeffries and Rizzolo (2006)[16], and psychometric properties (reliability and validity) were assessed by Franklin (2014)[18]. The reliability and validity of the Turkish version of the SDS scale is tested by Unver et al. (2017)[17]. The Cronbach alpha value is 0.90. The SDS evaluation scale consists of two parts; in the first section, the possibility of applying the best simulation design elements is evaluated. While, in the second section, the importance of the simulation design elements for the students is assessed. Higher scores from the first section indicate that the best simulation elements were employed, and higher scores from the second section indicate that students attach importance to the simulation experience[16].

Data Collection

This current study was carried out in three stages.

Stage 1: A total of 3 hours theoretical and 4 hours of practical courses on using UC were provided to all students who participated in this study. Demonstration and video display techniques of UC were also utilized during training. After the theoretical course and demonstration sessions, students were divided into three groups using a randomization method (Figure 1). The study program was given to the students two weeks before the SBE.

Stage 2: Before the simulation began, all students were asked to fill out a UC Knowledge test, approximately 16 minutes to complete. The simulation began with a pre-briefing where the students were informed about the simulation goals, the simulation method to be used, and the simulation laboratory. Students were informed about the simulation study and required not to share any information regarding the scenario with anyone. The same scenario was carried out with each group in the simulation. In groups with the whole-body simulator or partial UC simulator, a *low-fidelity simulator* was performed. In the group with the partial UC simulator and poster, a *medium-fidelity* simulator was utilized. The students' intergroup performances were evaluated using the UC Skill Checklist (First performance score). A suitable amount of time for conducting the simulations was scheduled for students. Each simulation lasted approximately 10 minutes and was followed by a 20-minute debriefing. The investigator conducted debriefing sessions through a plus/delta method.[19] In the debriefing session, each student discussed the simulation experience as well as their knowledge and skills regarding UC. Then, each participant was provided feedback about their performance. After completing the simulation and debriefing session, each participant was asked to fill out SSSC and SDS forms, which took approximately 10 minutes to complete.

Stage 3*:* The UC skills of all the students were evaluated via a hybrid simulation method that was one of the *high-fidelity* simulators. Hybrid simulation is the combination of more than one simulation modality for a single teaching or evaluation exercise.[20] Hybrid simulations allow training in technical skills combined with communication proficiency.[21] Prior to the implementation of hybrid simulation, the UC Knowledge Test was administered. The UC simulator was placed in the genital area while also ensuring the privacy and safety of the SPs. Thus, the perception was created that the simulator was SPs actual body part. After the scenario was provided to the participants, each of them completed the insertion of a urethral catheter within 10 minutes. At the same time, two instructors observed and evaluated students' skill performances through the UC Skill Checklist (First and second performance score). After the student's completed performance, the observers reviewed the checklist together and scored the student's performance.

Data Analysis

To carry out the statistical analysis for the study, the authors utilized the Statistical Package for Social Science (SPSS 16.0) software program. The descriptive statistics were provided in a number and percentage format, and the Kolmogorov–Smirnov test was used for examining a normal distribution of variables. Wilcoxon Signed-Rank test was used to compare knowledge and skill performance scores within the groups. The Kruskal-Wallis test was used to compare knowledge, skill performance scores, and the scales scores between the groups. Statistical significance was accepted at $p<0.05$.

Ethical Considerations

This study was approved by the ethical review boards of a university (Approval Number: 2016-273). The necessary permissions were also obtained from the school authorities before the outset of the study. All students who were randomly selected voluntarily accepted to participate in the study, and they were subsequently informed about the scenarios and the purpose and procedures to be carried out within the study. The necessary permission to utilize the scales discussed previously in this study was received from the authors.

Limitations

Since this current study was conducted at only one nursing school and had a small sample size, these findings cannot be generalized.

RESULTS

The characteristics of the participants are presented in Table 1. As a result of the Kruskal Wallis test, it was determined that the difference between the age of the student groups was not statistically significant ($p = 0.799$). As a result of the chi-square analysis, it was found that the difference between student groups in gender was not statistically significant ($p = 0.261$).

Table 1. Characteristics of the Participants (*n*=80)

Characteristics	Whole-body simulator (n=26)*	Partial UC simulator (n=26)*	Partial UC simulator with poster (n=28)*	Test	p
Age [median (min-max)]	20 (19-22)	20 (18-34)	20 (20-22)	X^2= 0.449**	0.799
Gender [n (%)]					
Female	20 (76.9)	22 (84.6)	26 (92.9)	X^2=2.689***	0.261
Male	6 (23.1)	4 (15.4)	2 (7.1)		

* Column percentages were given.
** Kruskal-Wallis Test
*** Chi-square test

Table 2 shows the distribution of median scores for the participant groups based on a variety of variables. The UC Knowledge Test score for each participant within all groups was found to have significantly increased ($p<0.05$). However, no significant difference was found between the participants' UC Knowledge Test scores from all groups ($p>0.05$). The UC skill performance scores of students as part of the whole-body model and partial UC simulator group did not significantly increase ($p>0.05$). Yet, those who were part of the partial UC simulator with poster group did significantly increase ($p<0.05$). Similarly, the difference in the UC skill performance score for the partial UC simulator with the poster group was significantly different ($p<0.05$). No significant difference was found between the participants' SSSC and SDS scores ($p>0.05$).

DISCUSSION

In this section, findings are discussed according to three categories: (i) Effects on knowledge, (ii) Effects on technical and non-technical skill, and (iii) Satisfaction and self-confidence.

The effectiveness of the three simulators was evaluated by adding a SP to the partial UC simulator (hybrid simulation, high-fidelity simulation). It was revealed in the results of this study that the knowledge scores of students from all three groups increased following participation in the simulation experience (Table 2), which suggests that the simulation experience was an effective tool for consolidating knowledge. It is recommended that information tests be administered to participants before SBE[22]. Administration of these tests can promote not only the readiness of participants but also increase their cognitive learning[11,12]. Kunst et al. (2017) find that simulation increase the level of students' knowledge.[23] Simulators used in SBE cover a wide range from low to high fidelity[11,12]. Sherwood and Francis (2018) carried out a meta-analysis of thirteen studies regarding the effects of simulators, which had various levels of fidelity, on the knowledge outcomes of students. It is revealed in the results of knowledge tests used in four studies that the increase in students' knowledge in the group with high-fidelity simulators is much higher than those from the group with low-fidelity simulators. In addition, according to this systematic review, no significant difference is evident in the knowledge scores of members from any groups in another six studies. While, in another five studies, based on the results of 1 to 2-week observations, it is revealed that there is no significant difference in the knowledge scores of groups who practiced on different simulators. Furthermore, no significant difference is found in three of the four studies regarding knowledge scores after a 2 to 6-month follow-up. However, in only one study, it is reported that scores of the group in which high-fidelity simulators are used significantly increased after three months. Finally, there is no evidence substantiating knowledge retention due to practice with high fidelity simulators when students are re-tested weeks or months following the SBE[24]. Although it is essential to decide on the simulators in accordance with the learning objectives of the SBE, we can say that the more fidelity, the more effective it is on learning.

Table 2. Comparison of Knowledge, Performances, SSSC and SDS Scores between Simulator Groups. (*n*=80)

	Whole-Body Simulator (n=26)	**Partial UC Simulator (n=26)**	**Partial UC Simulator with Poster (n=28)**	**X^2 †**	**p**
	Median (IQR)	**Median (IQR)**	**Median (IQR)**		
	(min / max)	**(min / max)**	**(min / max)**		
First knowledge score	12.5 (2) (8 /16)	12 (2.25) (7 / 15)	13 (2) (9 / 16)	X^2= 5.281	0.071
Second knowledge score	13 (2.25) (10 / 15)	12.5 (3) (6 / 16)	13.5 (2.75) (11 / 16)	X^2= 4.772	0.092
	z*= -2.718 **p= 0.007**	z*= -2.088 **p=0.037**	z*= -2.842 **p= 0.004**		
Difference of UC Knowledge Score	1 (2) (-2 / 5)	1 (3.25) (-4 / 7)	1 (2.75) (-2 / 4)	X^2= 0.059	0.971
First performance score	34 (6.25) (13 / 43)	29.5 (7.25) (9 / 41)	30.5 (7.5) (17 / 39)	X^2= 12.723	**0.002**
Second performance score	31.5 (9.5) (9 / 40)	30.5 (6.75) (13 / 41)	34.5 (5) (25 / 57)	X^2= 7.288	**0.026**
	z*= -2.010 p= 0.05	z*= -.781 p= 0.435	z*= -2.988 **p= 0.003**		
Difference of UC Performance Score	-2.5 (9) (-17 / 10)	3.0 (14.5) (-14 / 16)	4 (9) (-7 / 21)	X^2= 11.286	0.004
Satisfaction with current learning (SSSC)	4.6 (0.8) (4.0 / 5.0)	4.6 (1) (3.4 / 5.0)	4.6 (0.8) (1.0 / 5.0)	X^2= 1.507	0.471
Self-confidence in learning (SSSC)	4.35 (0.57) (3.14 / 5.0)	4.28 (0.71) (3.14 / 5.0)	4.14 (0.71) (1.57 / 5.0)	X^2= 0.547	0.761
Simulation Design Elements (SDS)	4.47 (0.65) (3.10 / 4.95)	4.37 (0.66) (3.45 / 5.10)	4.5 (0.84) (3.45 / 5.0)	X^2= 0.807	0.668
Importance of Simulation Design Elements (SDS)	4.55 (0.66) (3.5 / 4.9)	4.45 (0.43) (3.20 / 5.0)	4.55 (0.69) (3.45 / 5.0)	X^2= 1.484	0.476

†Kruskal-Wallis Test
* Wilcoxon Signed-Rank Test
IQR: Interquartile Range

This study determined that the second performance scores of the whole-body group decreased, while the UC skills mean performance scores of the partial UC simulator and partial UC with poster groups increased (Table 2). In the second phase of this study, the performance scores of students involved in simulation activities with three different simulators were evaluated using a hybrid simulation. It was determined that the performance scores of the partial UC simulator with the poster group increased significantly and did so much more than the other two groups (Table 2). A similar methodology to our study was utilized in Brady et al. (2013), where students' performances are evaluated by integrating the task trainer model with a medical illustration of a pregnant woman (Named Flat Maggie). As a result, it is determined that students do increase their clinical performance skills.[25] In their meta-analysis study, Sherwood and Francis (2018) examine the psychomotor results of five studies. In two studies, it was found that the skill performances of those who worked with a high-fidelity simulator increased immediately following SBE[24].

Cheng et al. (2015) also carries out a meta-analysis and concludes that in the adult life support scenarios, high-fidelity simulators produce better skill performance among the participants than simulators with a low level of fidelity[26]. In Sarmasoglu et al. (2016), students in the experimental group are trained with the hybrid simulation method by placing an injection pad on the SPs arm. It was found that students in the high-fidelity simulation group have higher performance scores regarding their injection practice on patients[27]. In a study conducted with nursing students to detect errors related to the use of the aseptic technique in urinary catheterization, Gonzalez and Sole (2014) reported that SBE using a task trainer is inadequate for achieving skills acquisition[28]. In our study, however, the performance scores of the group who performed the partial UC simulator with poster were found to have been higher in both intra-group and inter-group comparisons. We believe that the poster was perceived as an actual person. Thus, fidelity was likely ensured, so students were provided a better opportunity for utilizing their communication skills.

In our study, no statistical difference was determined in terms of the simulators used regarding students' satisfaction and self-confidence levels. In a study by Alamrani et al. (2018), the effectiveness of SBE and traditional teaching methods were evaluated, and no statistical difference was found in terms of student satisfaction[29]. In contrast, Lubbers and Rossman (2017) carried out a study on a sample of first-year nursing students and found that the medium-level fidelity simulation increased students' satisfaction and self-confidence[30]. Rubbi et al. (2016) found that students are generally satisfied with the activities in a skills laboratory and that 71% of participants are satisfied with their activities using static mannequins, while 60% are satisfied with the high-fidelity simulator.[31] No difference was found in terms of satisfaction and self-confidence in our study; it can be explained by the similarity of simulation design standards for all three groups.

Furthermore, it is reported that students' satisfaction and self-confidence are high in SBEs[7]. However, as previously discussed and indicated in the findings from this current study, the degree of fidelity from simulators did not produce significant differences in students' satisfaction and self-confidence. As a result, it is crucial in SBEs to select suitable simulators for achieving desired learning objectives. There is no guarantee that high-fidelity simulators are the most effective teaching tools for all training activities. Another parameter affecting students' satisfaction and self-confidence is the INACSL simulation design that provides best practice standards. In this study, the SDS mean score of students in three groups was very high, and in this regard, there was no difference. Also, in a study by Lubbers and Rossman (2017), the SDS mean score of students is very similar to that of this study. Therefore, it can be concluded that a well-planned and well-designed simulation design can effectively ensure students' satisfaction and self-confidence in their UC skills[30].

CONCLUSION

It was determined in the results of this study that the UC knowledge scores of participants in three groups significantly increased. In addition, the skill performance mean scores of participants from the partial UC simulator with poster were also found to increase significantly. When the UC simulation with different simulators was re-evaluated via a hybrid simulation, it was determined that only the scores of participants from the partial UC simulator with poster group were significantly high. In this respect, we recommend adding the poster to the simulation to help improve the performance scores (technical and non-technical skills) of nursing students.

Ethics Committee Approval: Approval was obtained from Ethics Committee of Ege University Faculty of Nursing (Approval date and number: 13.10.2016, 2016-273)

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Exhibitor Consent: All students who were randomly selected voluntarily accepted to participate in the study and they were subsequently informed about the scenarios as well as the purpose and procedures to be carried out within the study, and verbal consent was obtained.

Author's Contribution to the Paper

Study design: DS, TB, VU

Data collection: DS, TB, VU, NT, EB

Literature search: DS, NT, EB

Drafting manuscript: DS, TB, VU, NT, EB

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Yazar katkıları
Araştırma dizaynı: DS, TB, VÜ
Veri toplama: DS, TB, VÜ, NT, EB
Literatür araştırması: DS, NT, EB
Makale yazımı: DS, TB, VÜ, NT, EB
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