

The impact of a "clean intermittent catheterisation simulation escape room" on senior nursing students

AUTHORS

TULAY BASAK RN, PhD¹

SENEM DUMAN RN, MsC¹

GUL SAHIN KARADUMAN RN, PhD¹

1. Gulhane Faculty of Nursing, University of Health Sciences, Ankara, Türkiye

CORRESPONDING AUTHOR

TULAY BASAK Gulhane Faculty of Nursing, University of Health Sciences, Ankara, Türkiye. Email: tulay.basak@sbu.edu.tr

ABSTRACT

Objective: The study aims to examine the effect of a simulation escape room developed to practice clean intermittent catheterisation on senior nursing students' knowledge, satisfaction, and self-confidence in learning.

Methods: The study employed a single-group pre- and post-test design. The researchers developed a clean intermittent catheterisation simulation escape room based on Flow Theory. Students participated in the game immediately after receiving clean intermittent catheterisation training. A total of 102 students volunteered to take part in the study. Data were collected using a "Sociodemographic Questionnaire", "Knowledge Test", "Self-Evaluation Scale for Simulation Laboratory Practices", and "Student Satisfaction and Self-Confidence in Learning Scale". Numbers, percentages, means, and standard deviations were used to describe the data. The Kolmogorov–Smirnov test was used to assess normality. The Wilcoxon test was used to compare the students' pre- and post-test knowledge scores.

Results: The difference between students' pre- and post-test knowledge scores was statistically significant ($p = 0.001$). Students' levels of satisfaction and self-confidence were found to be notably high. They also expressed positive views regarding their self-evaluation of simulation laboratory practice scores.

Conclusion: The clean intermittent catheterisation simulation escape room positively influenced senior nursing students' "knowledge", "satisfaction and self-confidence in learning", as well as their "self-evaluation of simulation laboratory practices".

Implications for research, policy, and practice:

The demonstrated positive impact of a clean intermittent catheterisation simulation escape room may encourage nurse educators to integrate this approach into undergraduate nursing curricula.

What is already known about the topic?

- Performing urinary catheterisation is a complex and invasive procedure.
- Game-based strategies are recognised as an efficient way to engage and motivate students in clinical skills labs.

What this paper adds:

- The clean intermittent catheterisation simulation escape room can be successfully developed and implemented.
- The game positively influenced senior nursing students' knowledge, satisfaction, confidence in learning, and self-evaluation of simulation laboratory practices.

Key Words: Clean Intermittent Catheterisation; Nursing Students; Escape Room

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INTRODUCTION

Urinary catheterisation is a complex and invasive procedure.¹ The placement of urinary catheters has been associated with significant morbidity and even mortality.² Nursing students must acquire evidence-based urinary catheterisation skills before graduation to prevent complications, ensure patient safety, and strengthen their clinical competence and self-confidence.³⁻⁵ However, Bhatt et al. reported that the knowledge and skills of healthcare staff, including nurses, regarding urinary catheterisation remain inadequate.⁶ The authors also emphasised the need for training programmes that address different types of catheterisation, including clean intermittent catheterisation (CIC).⁶

Although many nursing programmes teach these skills in simulation laboratories, opportunities to practise in clinical settings may be limited.^{3,7} Students are often able to perform these procedures on real patients only when circumstances and institutional policies allow.⁴ Therefore, effective instructional strategies in simulation laboratories are essential. Nurse educators should establish environments that promote the development of clinical competence and foster students' confidence in delivering patient care. Innovative teaching approaches implemented in clinical skills laboratories may further enhance students' self-confidence.⁸

Game-based learning has been identified as an effective way to engage and motivate students in clinical skills training.⁹ Among these strategies, the simulation escape room has emerged as a novel pedagogical method for interactive learning.¹⁰ Simulation escape rooms typically require participants to solve clues and challenges within a specified time, creating a sense of urgency and competition. This strategy has been widely adopted in undergraduate health education programmes.¹¹⁻¹⁴ A systematic review by Veldkamp et al. reported that simulation escape rooms promote active learning and increase students' motivation and skill development.¹⁵

Kardong-Edgren et al. suggested that high-risk, low-frequency procedures such as urinary catheterisation are particularly suitable for game-based environments.¹⁶ Simulation escape rooms enhance learning by requiring students to collaboratively solve problems within structured scenarios, thereby strengthening communication and teamwork skills.^{17,18}

Simulation escape rooms have been used to teach a wide range of topics in nursing education.¹⁹⁻²³ However, most studies have focused on reinforcing theoretical content.²⁴ Although direct evidence regarding the use of simulation escape rooms, especially for CIC-specific training, remains limited, their adaptability to diverse clinical procedures suggests considerable potential. Integrating simulation escape room-based activities may address current educational gaps by promoting interactive, team-based

learning and increasing student engagement.²⁵ Further research is needed to explore the implications of simulation escape room use in nursing education and to identify best practices.²⁶ The present study aimed to evaluate the effect of a simulation escape room designed for CIC practice on senior nursing students' "knowledge", "satisfaction", "self-confidence", and "self-evaluation of simulation laboratory performance".

METHODS

DESIGN

This study had a singular group with a pre- and post-test design.

SETTINGS AND PARTICIPANTS

The study population consisted of 197 senior students enrolled in the Nursing Faculty during the 2022–2023 academic year. A convenience sampling method was used. The required sample size was calculated as 101 using G*Power Version 3.1 (effect size = 0.25, α = 0.05, power = 0.80). Students were eligible for inclusion if they had completed the theoretical instruction and simulation laboratory training on urinary catheterisation. Nine students who participated in the pilot study were excluded, and 86 students either declined to participate or did not meet the inclusion criteria. Ultimately, 102 students voluntarily participated and completed all components of the study.

Simulation Escape Room Development

The simulation escape room was designed using Flow Theory, which describes full engagement in an activity. Flow requires a balance between skill and challenge, clear goals, and immediate feedback.²⁷ According to Csikszentmihalyi, matching task difficulty with skill level is essential.²⁸ In this study, students progressed from simple to complex tasks, ending with the CIC procedure, ensuring an appropriate challenge–skill balance. Goals were clearly defined, and feedback was provided through sound cues (soft tones for correct steps and sharper tones for errors) to support motivation and guide performance.

A design team was established to develop the CIC-themed simulation escape room. The team consisted of three facilitators specialising in simulation-based learning in nursing education and CIC. All the facilitators have experience in managing pre-briefing, simulation, and debriefing.

The Healthcare Simulation Standards of Best Practice™ (HSSOBP™) does not have specific guidelines for escape rooms. All facilitators had experience in managing prebriefing, simulation, and debriefing processes. Although the Healthcare Simulation Standards of Best Practice™ (HSSOBP™) provides no specific guidance for ERs, the

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team designed the ERG based on recommendations from a literature review.²⁹⁻³¹ Pre-briefing, simulation, and debriefing components were designed and delivered in accordance with the HSSOBP™ directive.³²⁻³⁴

A single-scenario design was implemented across different rooms. The scenario involved a patient with sensory and motor loss whose indwelling urinary catheter had been removed 24 hours earlier, with no subsequent urine output. Learning objectives for practising CIC were clearly defined. Based on evidence recommending fewer than six students for high-fidelity simulations,³⁵ and considering available resources, it was decided that each game would include three students to allow closer observation. The simulation escape room environment was organised as five sequential activities within clinical simulation rooms (Table 1). To ensure that all students could participate, 17 sessions were held simultaneously across two clinical simulation rooms. Facilitators observed students from the control rooms and used auditory cues to indicate correct or incorrect responses. A stopwatch displayed elapsed time on the room monitor. The simulation escape room required learners to solve a series of puzzles to advance through the activities and achieve the learning objectives. Upon completing all tasks within the allotted time, teams gained access to a final box containing the key needed to escape the room.

Simulation Escape Room Procedures

Before beginning the activities, students were briefed on the rules, safety information, general procedures, and purpose of the escape room in line with the HSSOBP™ prebriefing standards.³²⁻³⁴ Students signed a fiction contract, which acknowledges the simulation nature of the scenario and supports full engagement as if it were real, and then formed their own teams, encouraging collaboration and creating a performance-oriented environment.

At the start of each session, students were reminded that all three team members were required to solve the tasks together. Once the door was locked, the 15-minute timer was activated. Students were directed to complete five activities within this time frame (Table 1). Facilitators observed the sessions from the control room, unseen by the students due to the one-way mirror with high reflectivity and low light transmission. Immediate feedback on each activity was provided through auditory signals indicating correct or incorrect responses. Each session concluded when the team either solved all activities or ran out of time. All games were video recorded in the simulation rooms (Supplementary Material).

TABLE 1. THE ACTIVITIES IN THE SIMULATION ESCAPE ROOM

Activities	Contents
1. Matching	The cards were mixed with five questions and answers related to the CIC practice. The student was asked to make the correct match between the question and the answer.
2. Word puzzle	There is a puzzle that consists of 10 questions about the CIC practice. A password with some letters was placed in the puzzle. The student was asked to find out this password.
3. Finding the materials for the CIC	Among the many medical supplies, the students were asked to find the materials that were necessary for the practice of the CIC.
4. The CIC practice steps	The students were asked to sort the CIC practice steps on the cards in the right order.
5. The CIC practice	The students were asked to perform the CIC practice on the high-fidelity simulator according to the application steps using the materials. Students who completed the CIC practice process correctly took the key from the box and escaped from the room.

The pilot study

A three-session pilot study was conducted with nine senior nursing students, who were not included in the main study. Feedback on the game was collected using a form developed by the researchers. Students recommended increasing the volume of the feedback sounds and enlarging the font size of the word puzzle. The final version of the game was revised in line with this feedback. The average durations for the pre-briefing, simulation escape room, and debriefing were set at 5, 10, and 25 minutes, respectively.

INSTRUMENTS

1. Sociodemographic questionnaire

This two-item questionnaire collected information on age and gender.

2. The CIC Knowledge Test

The CIC Knowledge Test was developed by the researchers based on the learning objectives. Content validation was performed by 10 expert lecturers in fundamental nursing. Expert opinions were evaluated using the Davis method,³⁶ yielding a content validity index of 0.97. A pilot test was conducted with 20 senior nursing students to assess item characteristics. Students completed the test in 10 minutes in a classroom setting. The item difficulty index was 0.56, and the mean discrimination index was 0.32. Two distractors were revised based on the results. Internal consistency was evaluated using the Kuder–Richardson 20 coefficient, which was 0.62. The test included 10 items, with a total possible score of 100, and was administered before and after the simulation.

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3. The Self-Evaluation Scale for Simulation Laboratory Practices (SES-SLP)

The SES-SLP is a self-report instrument developed in Turkish by Törüner et al. (2021) to evaluate the impact of simulation laboratory experiences on students' professional understanding, skills, and attitudes.³⁷ The five-point Likert scale contains 23 items across two subdimensions: "developing" and "challenging". Negatively worded items are reverse-coded. Scores range from 0 to 92, with higher scores indicating more positive perceptions of professional growth. Cronbach's alpha values reported in the original study were 0.94 (total), 0.96 (developing), and 0.73 (challenging).³⁷ In this study, Cronbach's alpha values were .81, .65, and .78, respectively.

4. The Student Satisfaction and Self-Confidence in Learning Scale (SSSC)

The SSSC was originally developed by Jeffries and Rizzolo, with the Turkish adaptation conducted by Ünver et al.³⁸ The Turkish version comprises 12 items divided into the subdimensions of "satisfaction" (5 items) and "self-confidence" (7 items). No negative items are included. Subdimension scores are calculated by dividing the total by the number of items. Reported Cronbach's alpha coefficients in the Turkish validation were .85 (satisfaction), .77 (self-confidence), and .89 (total).³⁸ In this study, Cronbach's alpha values were .90, .76 and .87, respectively.

DATA COLLECTION

Before initiating the study, the "Sociodemographic Questionnaire" and "CIC Knowledge Test" were administered in a classroom setting, with approximately 10 minutes allocated for completion. Students then received two hours of theoretical training from a faculty member specialising in CIC, comprising lectures, question-and-answer interactions, and demonstrations. Immediately afterwards, students participated in practical CIC training using a partial-task trainer. To ensure consistency between theoretical and practical instruction, both sessions were delivered by the same faculty member.

Following the training, students were pre-briefed according to the HSSOBTM guidelines.³⁴ After the escape room, a structured post-simulation debrief lasting approximately 25 minutes was conducted using the Promoting Excellence and Reflective Learning in Simulation approach.³²⁻³⁹ After the debrief, students completed the "CIC Knowledge Test", the SES-SLP, and the SSSC in a face-to-face setting in the debriefing room.

DATA ANALYSIS

IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, NY, USA), was used to analyse the data. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated. The Kolmogorov-

Smirnov test was used to assess the normality of the distribution. The Wilcoxon signed-rank test was employed to compare students' pre- and post-test knowledge scores. A significance level of $p < 0.05$ was accepted for all statistical decisions.

ETHICS

Ethical approval was obtained from the University Ethics Committee (date: 24 November 2022; number: 2022/154), and written institutional permission was granted before data collection. The study adhered to the principles of the Declaration of Helsinki.⁴⁰ The study procedures were explained to all students, and informed consent was obtained individually. Students were assured that they could decline participation or withdraw from the study at any time without penalty.

RESULTS

The students' mean age was 22.56 ± 1.17 years, and 93.1% were female.

The mean pre-test knowledge score was 65.29 ± 13.32 , while the mean post-test knowledge score was 76.76 ± 13.23 . The difference between the pre- and post-test scores was statistically significant ($Z = -6.461$; $p = 0.001$) (Table 2).

TABLE 2. COMPARISON OF PRE- AND POST-TEST KNOWLEDGE SCORES (N=102)

	Median (IQR)	Mean±SD (Min-Max)
Pre-test Knowledge Scores	70 (20)	65.09±13.32 (20-90)
Post-test Knowledge Scores	80 (20)	76.76±13.23 (30-100)
Test*	Z=-6.461	
P	0.001	

* Wilcoxon signed rank number test

The distributions of the SSSC and SES-SLP scores are presented in Table 3. The total SSSC score was 4.53 ± 0.38 , and the total SES-SLP score was 68.65 ± 5.29 . The students' mean "satisfaction" and "self-confidence" subscale scores were 4.74 ± 0.37 and 4.38 ± 0.43 out of 5, respectively, indicating high levels of satisfaction and self-confidence.

TABLE 3. THE STUDENTS' SSSC SCORES (N=102)

	Mean±SD	Min-Max
Satisfaction	4.74±0.37	4-5
Self-confidence	4.38±0.43	3.57-5
Total SSSC Score	4.53±0.38	3.75-5

Table 4 shows the distribution of the SES-SLP item scores. Students gave higher scores to items reflecting positive perceptions ("developing") and lower scores to items representing challenges ("challenging")—specifically items 6, 10, and 11.

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TABLE 4. THE STUDENTS' SES-SLP SCORES (N=102)

Questions	Mean± SD
1. Increased my level of knowledge	3.81±0.39
2. Increased my motivation	3.61±0.85
3. Made it hard for me to learn	3.14±1.52
4. Made me realize my mistakes	3.65±0.53
5. Improved my self-confidence	3.64±0.59
6. Made me feel inadequate	1.33±0.58
7. Developed my skill	3.65±0.53
8. Increased my attention	3.63±0.72
9. Reinforced my knowledge	3.44±1.64
10. Caused me to live in fear	0.29±0.45
11. Increased my level of satisfaction	3.56±0.58
12. Developed my communication skills	3.58±0.53
13. Increased my readiness	3.71±0.45
14. Developed my collaboration skills	3.70±0.47
15. Developed my observation skills	3.72±0.44
16. Made me see my lack of knowledge	3.71±0.47
17. Increased my assessment skills	3.54±0.71
18. Strengthened my professional values	3.67±1.61
19. Caused me to experience stress	1.71±1.18
20. Developed my decision making skills	3.38±0.73
21. Made me control my excitement	3.65±0.49
22. Increased my awareness	3.60±0.58
23. Increased my ability to work with the team	3.67±0.59

0 = I do not agree, 1 = I agree a little, 2 = I am undecided, 3 = I agree, 4 = I completely agree

DISCUSSION

In this study, the simulation escape room designed for CIC practice was found to improve nursing students' "knowledge", "satisfaction", "self-confidence", and "self-evaluation of simulation laboratory performance". The statistically significant increase in knowledge scores suggests that the escape room supported cognitive learning (Table 2), and students' responses to the SES-SLP item "increased my knowledge level" reinforce this finding (Table 4). While previous escape room research generally reports increased knowledge.^{11,41} The present study contributes more specifically to the literature by applying the escape room strategy to psychomotor procedural training—an area where evidence is still limited.

Psychomotor skill acquisition requires the integration of cognitive understanding, motor sequencing, and perceptual cues. Procedural competence develops through repeated exposure, structured guidance, and opportunities to refine technique. Research on psychomotor learning indicates that active engagement, problem-solving, and contextualised practice strengthen memory encoding and skill transfer.^{42,43}

In the present simulation escape room, puzzles and task sequencing may have supported these mechanisms by prompting students to recall procedural steps, interpret clinical cues, and apply decision-making within a simulation context. This structured cognitive rehearsal likely contributed to the observed knowledge gains.

High levels of student satisfaction and self-confidence were also identified. Beyond escape room pedagogy, these outcomes can be interpreted within the broader literature on procedural training and competency development. Self-confidence in technical skills increases when learners experience supportive challenges, timely feedback, and opportunities for autonomous performance—three elements known to enhance self-efficacy and subsequent competency.^{44,45} In this study, the progression from simple to complex tasks and the immediate feedback signals embedded in the escape room design align with these principles. Students' high motivation scores on the SES-SLP further support the role of challenge–skill balance, consistent with Flow Theory, in fostering engagement and confidence.²⁶

Although previous studies have reported positive effects of escape rooms on student satisfaction and confidence,^{46–49} these findings should also be viewed through the lens of clinical readiness. Newly graduated nurses often report anxiety and low confidence in performing invasive procedures such as catheterisation.⁵⁰ Learning environments that encourage autonomous decision-making and provide simulation-based mastery experiences have been shown to mitigate this gap.⁵¹ The escape room structure—requiring students to work collaboratively, make procedural decisions, and navigate a time-limited scenario—may have offered a psychologically safe yet challenging space for building procedural confidence.

Finally, students' SES-SLP scores indicated a positive perception of their developing professional skills and attitudes. While previous escape room studies with nursing students similarly report benefits for critical thinking, teamwork, and communication,⁴⁷ the relevance of these competencies is particularly evident in catheterisation training, where errors often stem from lapses in procedural sequencing, aseptic technique, or communication. The escape room may therefore support not only cognitive and motivational outcomes but also professional behaviours integral to safe catheterisation practice.

LIMITATIONS

The main limitations of this study are that it was conducted at a single centre, the sample consisted solely of senior nursing students, and no control group was used. Therefore, the findings cannot be generalised to all nursing students or other educational programmes. In addition, the effect of the simulation escape room on actual performance was not evaluated. The Cronbach's alpha value for the "challenging" subdimension of the SES-SLP scale was also lower than that reported in the original validation study.

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CONCLUSION

The CIC simulation escape room positively influenced senior nursing students' "knowledge", "satisfaction", "confidence in learning", and "self-evaluation of simulation laboratory practice". These findings indicate that simulation escape rooms are an effective and engaging teaching strategy. Integrating such approaches into undergraduate nursing curricula may enhance students' clinical preparedness and support learner-centred education.

IMPLICATIONS FOR RESEARCH, POLICY AND PRACTICE

The findings support simulation escape rooms as a promising educational strategy in nursing education. Further research employing larger and multi-site designs is warranted to examine long-term outcomes, including knowledge retention and clinical performance. Recognising simulation escape room approaches as structured strategies may support their integration into nursing curricula and accreditation standards. Integrating simulation escape rooms into skills laboratories may enhance student engagement, confidence and preparedness for clinical practice, particularly when supported by appropriate institutional and faculty development structures.

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