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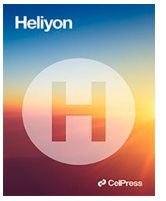

Research article

Comparing the efficacy of single-skill and multiple-skill simulation scenarios in advancing clinical nursing competency

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A R T I C L E I N F O

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A B S T R A C T

Aim: This study aims to compare the effectiveness of single-skill and multiple skills patient care simulation scenarios in enhancing nursing competency and to evaluate nurses' perceptions of these different simulation scenarios.

Methods: A mixed-method design was used. In the quantitative part, 130 newly hired nurses with less than one year of experience participated in this study. For the qualitative part, a subset of 26 of these nurses was selected for in-depth interviews until data saturation was achieved. The study was conducted in the simulation-based learning (SBL) lab in a specialized Jordan cancer center. Data collection took place between June 2022 and March 2023.

Results: A significant difference was found in the IV skill between single and multiple skills scenarios; the mean score for the single-skill group was 44.42 (SD = 3.85), the mean score for the multiple-skill group was 45.63 (SD = 2.26) (P = 0.014). Moreover, a significant difference was found between the pre-and post-test scores for single-skill and multiple-skill groups. The mean score for the medication skill scenario pre-intervention single group was (M = 23.90, SD = 5.33); however, the score was increased post-intervention (M = 45.38, SD = 3.33), (P = <.001). Furthermore, the mean score was raised in the multiple skills medication scenario from (M = 22.92, SD = 5.44) to (M = 45.72, SD = 2.75), (<.001).

Conclusion: Participants in both groups reported similar findings regarding physical exhaustion, scenario management, and overall satisfaction with the simulation experience. Loss of concentration and memory was reported more with multiple competencies simulation scenarios; this might indicate that this scenario has more cognitive load than the Single Competency Scenario.

1. Introduction

Enhancing clinical nursing competency is crucial for ensuring quality patient care and improving overall healthcare outcomes. Traditional methods of learning and training in nursing education often rely heavily on didactic lectures and limited hands-on experiences, which may not fully prepare nurses for the complex and dynamic healthcare environment they will encounter in their practice. However, with the advent of technology and innovative educational approaches, SBL has emerged as a powerful tool in nursing education. Simulation-Based Learning (SBL) is an innovative educational approach that has emerged from the health disciplines [1]. It is widely used in healthcare facilities as a unique methodology for replicating patient care experiences [2].

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SBL involves creating realistic scenarios that mimic clinical situations, allowing nurses to practice and refine their skills in a safe and controlled environment. These simulations can range from simple task training to immersive, high-fidelity experiences that closely resemble real clinical settings. By engaging in SBL, nurses can develop and enhance their clinical competencies, critical thinking abilities, communication skills, and teamwork, all of which are essential for providing high-quality patient care [3].

One of the key advantages of SBL is its ability to bridge the gap between theory and practice. Nurses can apply the knowledge and principles they learn in the classroom to simulated patient scenarios, enabling them to see the direct impact of their decisions and actions. This hands-on approach fosters active learning, promotes critical thinking, and encourages reflection as nurses analyze their performance and identify areas for improvement. Furthermore, SBL offers a safe environment for nurses to make mistakes and learn from them without compromising patient safety [4]. Through repeated practice, nurses can develop good memory, enhance their technical skills, and build confidence in their abilities. They can also navigate challenging situations, such as emergencies or complex patient interactions, in a controlled setting, which helps reduce anxiety and stress when facing similar situations in real clinical practice. Another significant benefit of SBL is its potential for interprofessional education and collaboration [5]. Healthcare services are a team effort, and nurses must work closely with other professionals to provide comprehensive, holistic patient care [6].

The complexity of patient care requires effective critical thinking and problem-solving strategies alongside clinical competence for optimal patient care outcomes. Many pieces of literature have indicated that simulation may improve nursing competency [7]. SBL is used in nursing progressively and was endorsed as a valid strategy; learners improved their knowledge, critical thinking ability, satisfaction, and confidence after attending a simulation session [8]. SBL facilitates the application of knowledge and skills, enabling new nurses to translate theoretical concepts into clinical practice [7]. Furthermore, new technologies in SBL, like virtual simulation found to be useful for learning new skills. Consequently, SBL plays a crucial role in training nurses in various procedures, helping to prevent medical errors and injuries while enhancing their competencies. This approach ultimately contributes to the protection of patient safety, a fundamental goal for all healthcare providers [9].

Simple simulation scenarios are designed to focus on one-dimensional skills, such as physical assessment, providing a straightforward learning experience for first-semester nursing students. In contrast, complex simulation scenarios, such as those simulating a myocardial infarction, involve multiple dimensions of nursing care, including assessment, intervention, communication, and multi-team interactions.

Literatures had many terms to name and describe simulation scenarios. Some literature has explored the effectiveness of different levels of scenarios and called them as simple or complex scenarios [10] and conclude that no significant difference was found between the means of the simple versus complex assignments on critical thinking, assessment, and learner satisfaction. Another study explored both simple and complex simulation scenarios for nursing students, indicating that simple scenarios are ideal for first-semester students, focusing on one-dimensional skills such as physical assessment. In contrast, complex scenarios, like those simulating a myocardial infarction, are more suited for advanced students or experienced nurses, as they involve multiple dimensions of nursing care, including assessment, intervention, communication, and multi-team interactions [11]. Other researchers studied the effect of simulation scenarios with single patient and scenarios that include multiple patients during hospital clinical experiences. Quantitative and qualitative data indicated that students perceived increased levels of confidence in their readiness to transition to practice following the multiple patients [12]. Similarly, multiple-patient assignments were perceived as necessary for senior nursing students to learn to effectively prioritize and delegate care [13].

In our study, we use single or multiple skill scenarios, similar to the approach in the literature. However, our context and population differ as we focus on graduated nurses in a real patient care setting, tailoring the scenarios to fit this specific group's needs.

The analysis of both quantitative and qualitative data revealed that students reported higher confidence levels in their preparedness to transition to practice after participating in multiple-patient simulations [12]. Moreover, senior nursing students were found to require assignments with multiple patients in order to effectively learn how to prioritize and delegate care [13]. This finding is further supported by a separate study that found nursing students generally expressed satisfaction with multiple patient simulations [14].

1.1. Aims and objectives

The study has the following aims:

1. To compare the effectiveness of single-skill versus multiple skills patient care simulation scenarios in enhancing nursing competency.
   - Objective 1: Assess the improvement in nursing competency following single-skill and multiple skills simulation scenarios.
   - Objective 2: Identify which type of simulation scenario leads to greater enhancement in nursing competency.
2. To evaluate how nurses perceive the different simulation scenarios.
   - Objective 3: Explore nurses' perceptions of the learning experience provided by single-skill and multiple skills simulation scenarios.
   - Objective 4: Investigate the impact of simulation scenarios on nurses' confidence and skill application in clinical practice.
3. To assess the quality of simulation-based learning (SBL) in improving nurses' competency for both single and multiple skills scenarios.
   - Objective 5: Evaluate the effectiveness of SBL in achieving desired learning outcomes in single-skill and multiple skills simulation scenarios.
   - Objective 6: Determine the key factors contributing to the quality of SBL in nursing education.
4. To explore staff nurses' perceptions of these simulation scenarios.

- Objective 7: Gather insights from staff nurses on the strengths and weaknesses of single-skill and multiple skills simulation scenarios.
- Objective 8: Identify recommendations for improving simulation-based training based on staff nurses' feedback.

2. Methods

2.1. Design

A mixed-method design was employed in the study to measure and explore the nurses' competence and their perception of the simulation training. The utilization of mixed methods research allows for a comprehensive and in-depth understanding of the phenomena under investigation [15]. By combining quantitative and qualitative data collection and analysis techniques, researchers can obtain a more holistic view of the nurses' competence levels as well as their subjective experiences and perspectives following the simulation training. The qualitative component of this study employed an exploratory descriptive design, using semi-structured interviews including open-ended questions to gain insights into nurses' perceptions of simulation scenarios.

2.2. Sample and setting

The study focused on recruiting newly hired nurses with less than one year of experience to participate. In order to establish specific inclusion criteria, the researchers targeted nurses who possessed a bachelor's degree in nursing, were newly hired, and had less than one year of experience. To ensure that the study examined the impact of the simulation training on nurses with limited experience, those who had previously attended the simulation lab for the identified competencies were excluded.

Recruitment was conducted through announcements and invitations sent via the hospital's internal communication channels, such as research boards. Interested nurses who met the inclusion criteria were invited to an informational session where the study's purpose, procedures, and confidentiality measures were explained. After providing informed consent, eligible nurses were enrolled in the study. In our study, we employed convenience sampling to select participants based on their accessibility and willingness to participate. To ensure an equal distribution of participants across the single-skill and multiple-skills simulation scenarios, groups were divided using random assignment. This approach aimed to minimize potential biases and enhance the internal validity of the findings, with the randomization process facilitated through a computer-generated method.

The sample size for the study was determined using power analysis. A medium effect size of 0.5, a significance level (alpha) of 0.05, and a power of 0.8 were considered. Regarding the qualitative method, participants' perceptions were explored until the point of data saturation was reached, a point at which no new information or themes emerged from the interviews.

2.3. Measurement

A quantitative data instrument consisting of two parts were used. The first part consists of the sociodemographic data sheet, including patients' age, gender, education level, and experience. The second part includes the Lippincott procedures competency checklist with a numerical grading system. The competency level of nurses in both groups was evaluated before and after the simulation to measure any changes. A competency checklist tool was utilized by the simulation facilitator during the scenario to assess the performance of the staff. The checklist covered several competencies, including medication administration (consisting of 25 items), IV peripheral cannulation (24 items), and pain assessment and management (36 items). These checklists were adopted from Lippincott procedures and featured a grading system ranging from zero to two for each item. To ensure content validity, a panel of experts from Jordanian universities reviewed and confirmed the appropriateness of the scale.

Qualitative data was collected through an in-depth semi-structured interview to assess nurses' perception post-simulation. Semi-structured interviews were conducted in Arabic, the first language of the staff members, to facilitate effective communication. The interview sessions were recorded and subsequently played back twice. The recordings were then transcribed into written Arabic text and organized in a table format. Each participant's code was followed by their responses to the respective interview questions. Subsequently, the research team, consisting of bilingual members proficient in both Arabic and English, undertook the translation process. The Arabic text was translated into English, ensuring accurate and faithful representation of the participants' input. To maintain data integrity and objectivity, all steps of recording conversion and translation were carefully verified and cross-checked by two independent members of the research team.

2.4. Data collection procedures

After obtaining the IRB approval, the newly hired nurse's list was reviewed to assess the eligibility for participation. The researcher contacted the participants to inform them about the study and to request their participation. Data were collected between June 2022 and March 2023. In this investigation, nurses were divided into two distinct groups, each undergoing unique simulation scenarios to evaluate their skill development. The initial group participated in single-skill simulation scenarios, designed to enhance one specific nursing competency per session. These scenarios closely mirrored real-life clinical environments, enabling participants to concentrate on refining a singular skill. Each session, conducted in settings akin to typical clinical environments, lasted about 30 min. In contrast, the second group was immersed in a comprehensive, multiple-skills simulation scenario. This elaborate session blended three fundamental nursing competencies into a single, dynamic simulation, replicating the intensity and complexity of actual clinical

situations. Lasting an hour, this scenario required nurses to simultaneously apply a variety of skills, thus mirroring the multifaceted nature of nursing duties.

To evaluate the impact of these simulations, both quantitative and qualitative methods were used. Quantitative assessments involved tests conducted before and after the simulations, gauging improvements in particular nursing skills and overall competency. These assessments utilized established tools recognized in nursing education, ensuring their reliability and relevance. Qualitatively, nurses' perceptions through interviews and surveys post-simulation were explored. These tools were crafted to gather insights on the realism, educational value, and overall effect of the simulation scenarios on the nurses' learning experience and confidence in applying their skills.

2.5. Data analysis

The Statistical Package for Social Sciences (SPSS) (version 26) was used to analyze the quantitative data. Descriptive statistics were used to describe the study variables based on the level of measurement. At the same time, content analysis was used in order to gain insight into nurses' experiences.

Qualitative thematic analysis was commenced directly to generate and develop themes that can be used to describe the nurse's experience. Thematic analysis was conducted through familiarization with the data, coding, theme development, review and refinement, finalization of themes, and reporting of results. This approach allowed for a comprehensive understanding of participants' experiences and perspectives, contributing to the study's findings on the impact of simulation scenarios in nursing education. The trustworthiness of the qualitative analysis was established through strategies ensuring credibility, transferability, confirmability, and dependability, such as member checks, thick descriptions, an audit trail, and inquiry audits. Additionally, to ensure accurate data collection, simulation (SIM) facilitators were trained on conducting and managing semi-structured interviews to gather rigorous and rich data. Emergent themes were reviewed by expert clinical educators to verify their appropriateness and realism.

In this study, the analysis of quantitative data and qualitative open-ended questions was conducted separately, with the findings being merged during the interpretation phase.

2.6. Ethical considerations

Ethical approval from the institutional review board (IRB) was obtained to conduct the study. Participation was voluntary, and all participants had the right to refuse or withdraw from the study at any time without any consequences. Written consent was obtained from the participants.

3. Results

3.1. Quantitative results

A total of 150 participants were initially recruited for this study, but data were collected from 130 participants after 20 dropped out due to long leaves or resignation. Table 1 shows the demographics for the included participants. A total of 130 (100 %) participants were nurses. Most nurses were single, 128 (98.5 %), and all had less than one year of experience (100 %). The mean participants' age was 21.65 (SD 0.8). Detailed demographic information of the study sample is presented in Table 1.

Table 2 shows how demographic characteristics were distributed between the two testing groups. Most single-skills group participants worked in wards 39 (60 %), while around 26 participants (40 %) in the multiple-skills group worked in the special units. So, there was a significant difference between the participants working in two groups p-value of 0.004. All other variables had no difference; this indicates the two groups were almost similar at the beginning of the study.

Table 3 provides a descriptive summary of the overall scores for all participants before and after the intervention. It includes the mean scores and standard deviations for both the pre-intervention and post-intervention assessments. Significant differences existed

Table 1
Participants' demographics.

Variable		Frequency	Percentage
Unit	Ward	65	50.0
	Special unit	57	43.8
	Ambulatory	8	6.2
Marital status	Single	128	98.5
	Married	2	1.5
	Total	130	100.0
Education	BSc	130	100 %
Experience	Less than one year	130	100 %
Gender	Male	41	31.5
	Female	89	68.5
Variable		Mean	Std. Deviation
Age		21.65	0.80

Table 2
Demographic characteristics distribution between the two testing groups.

Variable		Single		Multiple		P
		Frequency	Percentage	Frequency	Percentage	
Unit	Ward	39	60 %	26	40 %	0.004
	Special unit	26	40 %	31	47.7 %	
	Ambulatory	0	0	8	12.3 %	
	Total	65	100 %	65	100 %	
Marital status	Single	63	96.9 %	65	100 %	0.496
	Married	2	3.1 %	0	0	
	Total	65	100 %	65	100 %	
Education	BSc	65	100 %	65	100 %	NA
Experience	Less than one year	65	100 %	65	100 %	NA
Gender	Male	20	30.8 %	21	32.3 %	1
	Female	45	69.2 %	44	67.7 %	
	Total	65	100 %	65	100 %	
Variable		Single		Multiple		P
		Mean	SD	Mean	SD	
Age		21.69	0.983	21.60	0.581	0.51

between the total pre and post-intervention scores for all simulation skills scenarios (P = < 0.001). Concerning the medication, pain, and IV cannula skills, a significant difference was observed between the mean scores of pre-intervention (M = 23.41, 28.61, and 38; SD = 5.42, 6.43, and 5.25, respectively) and post-intervention (M = 45.55, 60.27, and 45.02; SD = 3.05, 5.5, and 3.2, respectively; P < 00.001). The pre-test scores between the two groups were compared to ensure that both groups had equivalent baseline scores. There was no significant difference when comparing the pre-test scores for all skills scenarios for both groups (P= > 00.05) (Table 4).

Table 5 displayed a significant difference in the post-IV skill between single and multiple skills scenarios; the mean score for the single-skill group was 44.42 (SD = 3.85), the mean score for the multiple-skill group was 45.63 (SD = 2.26) (P = 0.014). Table 6 showed significant differences between the pre-and post-test scores for single-skill and multiple-skill groups. The mean score for the medication skill scenario pre-intervention single group was (M = 23.90, SD = 5.33); however, the score was increased post-intervention (M = 45.38, SD = 3.33), (P = <.001). Furthermore, the mean score was raised in the multiple skills medication scenario from (M = 22.92, SD = 5.44) to (M = 45.72, SD = 2.75), (<.001). Detailed information about the pre-and post-test scores for single-skill and multiple-skill groups is found in Table 6.

3.2. Qualitative results

3.2.1. Theme 1: simulation as a learning experience

In this study, nurses expressed positive perceptions of their simulation learning experiences, regardless of whether they participated in single or multiple scenarios. They regarded these experiences as excellent opportunities to acquire new knowledge and skills. Notably, the nurses did not report experiencing physical exhaustion as a result of the simulations. However, some participants mentioned encountering mental and cognitive disturbances, which will be further explored in the upcoming subthemes. These findings align with the existing international literature, suggesting consistency between the results of this study and previous research in the field.

3.2.1.1. Sub-theme 1.1: physical burden. Nurses reported no physical exhaustion in both single and multiple simulation scenarios. This indicates a negligible difference in physical well-being across simulation designs. Key quotes support this:

- "It was a new, enjoyable experience. I felt some stress but no exhaustion, and it met all my learning goals" (Participant 21, Multiple Competency Scenario (MCS)).
- "The session was insightful. I learned much, corrected past mistakes, and experienced no tiredness" (Participant 25, Single Competency Scenario (SCS)).

These comments suggest that neither simulation type significantly affects the nurses' physical condition, focusing on positive

Table 3
Descriptive analysis.

Variable	Pre				Post				P
	Min	Max	Mean	SD	Min	Max	Mean	SD	
Medication	8.50	37.00	23.41	5.42	31.00	51.00	45.55	3.05	< 0.001
Pain	11.50	45.00	28.61	6.43	37.00	70.50	60.27	5.50	< 0.001
IV cannula	8.50	38.00	22.93	5.25	20.50	49.00	45.02	3.20	< 0.001
Total	11.67	36.83	24.98	4.94	29.50	55.33	50.28	3.34	< 0.001

Table 4
Independent *t*-test analysis for the normally distributed variables.

		N	Mean	Std. Deviation	Minimum	Maximum	P
Pre Medication	Single	65	23.9000	5.39980	8.50	35.00	0.306
	Multiple	65	22.9231	5.44736	12.00	37.00	
	Total	130	23.4115	5.42477	8.50	37.00	
Pre Pain	Single	65	29.4462	6.27440	11.50	40.00	0.142
	Multiple	65	27.7846	6.54132	15.00	45.00	
	Total	130	28.6154	6.43860	11.50	45.00	
Pre IV	Single	65	22.9462	5.54395	8.50	33.50	0.974
	Multiple	65	22.9154	4.98323	11.50	38.00	
	Total	130	22.9308	5.25060	8.50	38.00	
Pre Total	Single	65	25.4308	4.99122	11.67	34.17	0.307
	Multiple	65	24.5410	4.90385	16.00	36.83	
	Total	130	24.9859	4.94870	11.67	36.83	

Table 5
Non-parametric tests for the abnormally distributed variables Mann Whitney test.

		N	Mean	S.D	Minimum	Maximum	P
Post Medication	Single	65	45.38	3.33	31.00	51.00	0.635
	Multiple	65	45.72	2.75	36.00	50.50	
	Total	130	45.55	3.05	31.00	51.00	
Post Pain	Single	65	59.63	5.28	37.00	67.50	0.092
	Multiple	65	60.91	5.69	40.00	70.50	
	Total	130	60.27	5.50	37.00	70.50	
Post IV	Single	65	44.42	3.85	20.50	47.50	0.014
	Multiple	65	45.63	2.26	34.50	49.00	
	Total	130	45.02	3.20	20.50	49.00	
Post Total	Single	65	49.81	3.673	29.50	54.17	0.067
	Multiple	65	50.75	2.934	40.67	55.33	
	Total	130	50.28	3.345	29.50	55.33	

Table 6
Comparison of the pre and post scores.

		Groups		P	
		Single	Multiple	Pre	Post
Medication	Pre	23.90 (5.33)	22.92 (5.44)	0.306	0.635
	Post	45.38 (3.33)	45.72 (2.75)		
	P	< 0.001	< 0.001		
Pain	Pre	29.44 (6.27)	27.78 (6.54)	0.142	0.092
	Post	59.63 (5.28)	60.91 (5.69)		
	P	< 0.001	< 0.001		
IV cannula	Pre	22.94 (5.544)	22.91 (4.983)	0.974	0.014
	Post	44.42 (3.857)	45.63 (2.268)		
	P	< 0.001	< 0.001		
Total	Pre	25.431 (4.991)	24.541 (4.904)	0.307	0.067
	Post	44.423 (3.857)	45.631 (2.268)		
	P	< 0.001	< 0.001		

learning outcomes without physical fatigue.

3.2.1.2. Sub-theme 1.2: psychological status. On the psychological level, nurses expressed that they were happy and comfortable. At the same time, few participants reported being stressed because of the camera monitoring. This was reported a bit more in the single competency simulation scenarios. Following is a sample from one of the single scenario participants: "One of the challenges that I experienced is stress, the duration of the session was acceptable, I lost some of my concentration, at the beginning the scene was difficult then become manageable (Participant 13, SCS)."

3.2.1.3. Sub-theme 1.3: cognitive load. The study highlighted the cognitive effects, especially on memory and concentration, in simulation scenarios. Participants noted concentration lapses in both single and MCSs, more frequently in the latter. Most, however, maintained high concentration in both types, meriting further study. Regarding memory, MCSs were linked to more memory loss incidents than single ones, indicating a potentially higher cognitive load. Participant experiences illustrate this:

- "I forgot a lot initially, but the simulation helped me organize my thoughts. It was new and beneficial, leaving me comfortable and happy" (Participant 4, MCS).
- "Handling the manikin was tricky, leading to occasional loss of focus. However, the session was overall manageable" (Participant 16, MCS).

These accounts suggest greater cognitive challenges, particularly with memory and focus, in MCSs, calling for more research into cognitive demands and enhancing simulation effectiveness.

3.2.2. Theme 2: simulation learning value

The value of SBL in nursing education was a prominent theme in this study. Participants recognized the importance of simulation scenarios in enhancing their clinical skills, decision-making abilities, and overall confidence. The simulation experiences were viewed as integral to bridging the gap between theoretical knowledge and practical application, thereby increasing the perceived value of SBL in preparing nurses for real-world challenges. This theme is further explored through the following sub-themes.

3.2.2.1. Sub-theme 2.1: effectiveness of simulation in meeting learning goals. In this study, participants from both the SCS and MCS groups expressed unanimous agreement regarding the benefits of the simulation experience. They indicated their willingness to repeat the experience and recommended others to attend similar sessions. Furthermore, participants from both groups reported that all of their training objectives were successfully accomplished. This overall satisfaction demonstrates a high level of participant satisfaction with the simulation training.

- One participant stated the following: "As expected, I achieved all my learning objectives." (Participant 15, MCS)

This statement exemplifies the participants' positive perception of achieving their intended learning outcomes through simulation training. The consistency in participants' satisfaction across both groups further supports the efficacy and effectiveness of the SBL experiences in this study.

3.2.2.2. Sub-theme 2.1: impact on high-order thinking skills. This study shows participants in both single and MCSs achieved the first three Kirkpatrick Model levels: satisfaction, knowledge, and skill development. However, the fourth level, evaluating learning's impact on nursing care and high-order thinking, showed differences. Participants from both groups acknowledged the simulation's role in linking scenarios to real nursing care. However, the influence on care organization varied. Those in the multiple competency group reported improved care organization, while single competency participants found their ideas less organized. The multiple competency group also noted gains in time management and critical thinking, a benefit not as pronounced in the single competency group.

A representative comment was: "The simulation was enjoyable and beneficial, helping me link medication to patient history. I felt comfortable and happy during the session" (Participant 10, MCS).

These insights underline the simulation training's positive effect on theoretical knowledge application in patient care, with MCSs possibly offering greater benefits in critical thinking and care organization.

3.2.3. Theme 3: managing simulation scenarios

Participants from both single and MCS groups reported similarly positive experiences in managing their simulation sessions. They praised the time allocation and found the scenario duration suitable. Both groups felt the scenarios were manageable without significant challenges. Representative comments include:

- "No major issues; initially stressed, but found the session manageable with excellent focus" (Participant 10, MCS).
- "No problems encountered; the time was adequate, and the scenario straightforward" (Participant 2, SCS).

These reflections underscore the participants' smooth experiences, highlighting effective scenario navigation. The feedback about manageable scenarios, appropriate timing, and clear directions indicates a well-executed simulation design, contributing to a successful and satisfying learning experience for all participants.

4. Discussion

The simulation as a learning Experience theme has visualized the participant's physical, psychological, and cognitive aspects when exposed to simulation learning experiences in both single and multiple simulation scenarios compared to similar simulation experiences in previous studies. Although that simulation experience allows nurses to obtain comprehensive learning outcomes, it may also impact their feelings of fear and anxiety [16].

Some qualitative studies of the lived experience of nursing in simulations reported positive experiences, like learning practices without fear, gaining confidence, and maturing in awareness and understanding. However, negative experiences, such as anxiety and uncertainty, were also reported. This was justified as the simulation is a complex learning environment with artificial nature that incorporate role-play, fear of mistakes, camera recording, teachers' observations, and nursing performance [17]. In fact, many studies found that simulation affects physical and mental aspects. Additionally, It has cognitive burdens, which were linked to the level of

awareness, understanding status during simulation, cognitive load, and memory status [17]. Moreover, it is stated in INACSL Standards that learners become fairly vulnerable when they are placed within a simulation-based experience, and this can affect self-esteem, create a sense of distrust in professional relationships, loss of a safe learning environment, and alteration of group dynamics [18].

Akselbo & Aune found that learners felt physical stress through a higher pulse and increased sweating [19]. However, this was perceived to help them better remember the skills learned in the simulation. On the psychological level, nurses expressed that they were happy and comfortable. At the same time, few participants reported being stressed because of the camera monitoring. Unexpectedly, this was reported a bit more in the single competency simulation scenarios, which may be because they require to go through different simulation steps with each competency scenario as they will have three simulation scenarios. In each, they shall be pre-briefed, act on the scenario, then will be debriefed. This may have caused more stress in the single competency simulation scenario.

On the other hand, having an immersive experience with other team members may decrease the stress level in multiple competencies scenarios. This is crucial as, despite the effectiveness of simulation learning, the associated stress and anxiety may interfere with the learners' memory of their experiences, and that learning can be affected [17]. In the literature, some participants experienced different stress levels during the simulation situation, while others felt performance anxiety [20]. Learners may be embarrassed and frustrated when faced with unexpected situations during the simulation scenario [21]. Furthermore, anxiety was also reported but did not significantly impact clinical judgment [22]. Surprisingly, multiple competency design may be less stressful, and this may need more investigation for more elaboration and insight.

Regarding the cognitive load, variant stress and anxiety levels are expected with the SBL experience. Some learners believe this stress and anxiety may help maximize their learning experience. On the other hand, other literature thinks this is connected to cognitive abilities, such as problem-solving, and negatively impacts learning. A study highlighted that stress might interfere with the student's memory of their experiences and that learning is lost due to performance criticism [17]. This is very arguable because another study highlighted that simulation enables learners to practice their clinical and decision-making skills in a protected environment. The sense of security enhances students' self-esteem and confidence, thus promoting learning [23]. On the other hand, simulation is connected with nurses' cognitive load. Different simulation designs can potentially increase or decrease cognitive load, which may be reflected in learning outcomes as endorsed by some literature [24]. Loss of concentration and memory was reported more with multiple competencies simulation scenarios; this may indicate that this scenario has more cognitive load than the SCS.

The evaluation of SBL can be approached from various levels, and Kirkpatrick's Model has been commonly used as a framework for assessing the impact of simulation learning experiences. The model provides a structure for evaluating four levels: reactions, learning, behaviors, and results (impact) [25]. In this study, it is apparent that both the SCS and MCS training sessions achieved the first three levels of simulation evaluation, which aligns with findings from international studies.

The present study's findings are consistent with this evidence, as participants reported positive reactions, knowledge acquisition, and skill development. Additionally, it has been determined that simulation activities effectively enhance learning satisfaction [26]. Therefore, the results of this study confirm that both training scenarios successfully attained the first three levels of simulation evaluation according to Kirkpatrick's Model. This demonstrates the positive impact of SBL on participants' reactions, learning outcomes, and observed behaviors, reinforcing the value of simulation-based training in healthcare education and training settings. SBL has been consistently reported to have a positive impact on higher-order thinking skills, including critical and reflective thinking, as supported by studies such as [27]. Additionally, SBL has been associated with the development of various other areas such as clinical procedures, teamwork, communication skills, situational awareness, task and time management, critical thinking, clinical reasoning, and decision-making, as noted in the research conducted by Ref. [28]. In this study, participants affirmed that the simulation scenarios were manageable, and no significant difficulties were encountered [28]. This aligns with the findings of our study, where both the SCS and MCS groups expressed similar perspectives. However, it should be noted that other studies have highlighted challenges faced by learners in dealing with complexity during simulation. These challenges include difficulties in preparing for simulation and managing complex scenarios, as discussed in work by Ref. [29].

In light of the existing knowledge about simple and complex simulation scenarios, there is a need for further research to understand the emotional dimensions, such as fear and anxiety, associated with these learning experiences. While previous studies have the impact of simulation on various aspects of nursing education, few have investigated into the differences between simple and complex scenarios in relation to these emotional factors. This gap in the literature underscores the importance of examining nurses' perceptions of simulation scenarios to gain a deeper understanding of their emotional responses and implications for learning.

4.1. Limitations

The study has two primary limitations. First, it employs a cross-sectional design, focusing on immediate outcomes without exploring the sustained effects of simulation scenarios on nursing competency. A longitudinal approach in future research would provide valuable insights into the long-term efficacy of simulation-based learning in nursing education. Second, the sample size, consisting of two groups with 65 participants each, may be considered modest. Expanding the sample size in subsequent studies would enhance the generalizability of the results, facilitate more nuanced analyses, and improve the statistical power to detect subtle differences.

5. Conclusion

Considering these findings, while both the SCS and MCS designs in our study were manageable and did not pose significant

challenges, it is noteworthy that higher-order thinking skills appeared to be more evident in the MCS group. The MCS may have provided participants with a greater opportunity to engage in complex decision-making and critical thinking, leading to the development of these higher-order thinking skills.

The study's findings indicate that participation in simulation lab scenarios can lead to physical exhaustion and memory loss among participants. This outcome suggests that the intensity and cognitive demands of the simulation exercises may contribute to a decrease in physical energy and an impaired ability to retain information. Physical exhaustion may result from the prolonged engagement in simulation activities that require sustained physical and mental effort. Memory loss, on the other hand, could be attributed to the high cognitive load imposed by the simulation scenarios, which challenges participants' ability to process and store information effectively.

Themes.

Theme	Sub-theme
Simulation as a Learning Experience	1. Physical Burden 2. Psychological Status 3. Cognitive load
Simulation: Learning Value	1. Learning outcome 2. Impact on high order thinking skills
Managing Simulation Scenarios	–

CRediT authorship contribution statement

Sami Alyateem: Writing – original draft, Methodology, Investigation, Conceptualization. **Majeda Al-Ruzzieh:** Writing – review & editing, Project administration, Conceptualization. **Bahaa Shtayeh:** Data curation, Validation, Investigation. **Aladeen Alloubani:** Writing – review & editing, Supervision, Formal analysis.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interestsAladeen Alloubani reports administrative support and article publishing charges were provided by King Hussein Cancer Center. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e29931.

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