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## Nursing Students' Perceptions of Using Branching Simulation: A Qualitative Descriptive Study

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### Abstract

Previous intervention studies have shown that branching simulation (BS) unfolds the complex multidimensional aspects of challenging health problems. The present study aimed to examine graduate nursing students' perceptions of using BS in professional training. This study used a qualitative descriptive design with semi-structured interviews with a sample of 20 graduate nursing students. Four main themes emerged from the results: (a) BS as a support to students' professional training, (b) BS leads to changes in clinical practice, (c) whether BS is a stressful learning experience, and (d) BS versus traditional lecturing. The participating students perceived BS as a valid learning tool that enables them to improve their critical thinking and decision-making skills, self-confidence, practical and theoretical preparation, and multidisciplinary teamwork and collaboration. Despite the identified advantages of BS, future research is needed to examine the effectiveness of incorporating BS in nursing practice.

### Keywords

branching simulation, nursing students, qualitative descriptive, sepsis

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# Nursing Students' Perceptions of Using Branching Simulation: A Qualitative Descriptive Study

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Previous intervention studies have shown that branching simulation (BS) unfolds the complex multidimensional aspects of challenging health problems. The present study aimed to examine graduate nursing students' perceptions of using BS in professional training. This study used a qualitative descriptive design with semi-structured interviews with a sample of 20 graduate nursing students. Four main themes emerged from the results: (a) BS as a support to students' professional training, (b) BS leads to changes in clinical practice, (c) whether BS is a stressful learning experience, and (d) BS versus traditional lecturing. The participating students perceived BS as a valid learning tool that enables them to improve their critical thinking and decision-making skills, self-confidence, practical and theoretical preparation, and multidisciplinary teamwork and collaboration. Despite the identified advantages of BS, future research is needed to examine the effectiveness of incorporating BS in nursing practice.

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## Introduction

Intensive care unit (ICU) patients may have life-threatening conditions that cause multiple vital organ failures and death (Rababa et al., 2022). The prompt management of these conditions is essential for improved health outcomes and the quality of care provided for ICU patients (van den Hengel et al., 2016). For example, the first three hours of the onset of sepsis symptoms are considered "golden hours," and they are critical for effective sepsis management (Rahman et al., 2019). ICU patients require multi-component interventions that incorporate stepwise actions and necessitate systematic analytical decision-making (Jacobs, 2020). Nurses play a significant role in making decisions related to the assessment and management of ICU patients' health conditions. However, numerous studies have indicated that nurses struggle with making complicated treatment decisions (Rahman et al., 2019; Storozuk et al., 2019). Studies have also highlighted the significance of continuing education and training to improve ICU nurses' decision-making and critical thinking skills, knowledge, attitudes, and practice, especially related to the assessment and management of challenging health problems (Storozuk et al., 2019; Yousefi et al., 2012). Accordingly, innovative training strategies should be adopted to encourage nurses to manage complicated problems effectively and adequately and improve the quality of care provided for ICU patients (Jacobs, 2020; Rababa et al., 2022).

Simulation-based learning provides a unique opportunity for trainees to improve their knowledge acquisition and retention and decision-making skills (Rababa, 2021; Rababa & Masha'al, 2020). It also helps trainees incorporate both practice and theory and improve their

problem-solving skills (Kovach & Rababa, 2014). Therefore, it is essential that trainees are sufficiently trained to utilize inventive learning strategies without causing any potential threat to real patients' lives (Dabney et al., 2020). Previous studies have approved that simulation, particularly branching simulation (BS), can significantly improve nursing students' and nurses' learning outcomes (Dabney et al., 2020; Kovach & Rababa, 2014). BS is a computer-based simulation that guides the trainee through complex branches of the decision-making process related to simulated case scenarios (Dabney et al., 2020). It provides trainees with all possible options, including both correct and incorrect options, for making a treatment decision, which allows trainees to examine the consequences of their choices. BS also enables trainees to understand their shortcomings and enhance their capabilities, as it offers immediate feedback about their selections (Rababa & Masha'al, 2020). Trainees appreciate this immediate feedback, as it helps them self-assess and improve their performance, determine their level of understanding, and adjust their selections accordingly (Alduraby & Liu, 2014). Analytic decision-making theory describes the process that the trainees apply to analytically make decisions in challenging clinical situations. The analytic decision-making process aims to gain the in-depth information utilized to reach correct and prompt decisions and to apply a systematic and logical decision tree. The recurrent and prompt feedback provided using BS is also congruent with learning theory (Kovach & Rababa, 2014). This theory provides a clear explanation of the effectiveness of immediate and goal-directed feedback provided by BS in highlighting the mistakes that have been committed and the justifications for correct and incorrect choices; thus, leading to correct decisions at the end (Rababa, 2021; Rababa & Masha'al, 2020).

In Jordan, nursing schools still over-rely on traditional teaching, which explains why we still lag behind the West when it comes to self-directed learning (Rababa & Masha'al, 2020). It is essential for innovative learning strategies to be integrated into nursing programs to well-prepare nursing students to effectively respond to the needs of challenging patients in the real life (Rababa, 2021; Rababa & Masha'al, 2020). In Jordan, considering the overcrowded classrooms and continuing shortage of nursing instructors, there is an imperative need for nursing schools to substitute traditional teaching methods with innovative teaching methods such as BS. BS is associated with high student motivation, commitment, and engagement with colleagues, nurse educators, and teaching materials (Rababa, 2021; Rababa & Masha'al, 2020). By incorporating BS in clinical practice, the issue of high student-faculty ratios no longer exists. BS provide students with the independent interactive, safe learning environment and rehearsal opportunities required for enhancing decision-making and critical thinking skills. BS is associated with enhanced self-confidence with effectively and independently responding to complex clinical situations (Rababa, 2021; Rababa & Masha'al, 2020).

Although previous studies have found BS to be associated with improved clinical outcomes, such as treatment fidelity (Kovach & Rababa, 2014), and learning outcomes for nursing students (Rababa & Masha'al, 2020), the development of BS is time-and money-consuming and associated with technical issues (Kovach & Rababa, 2014). Furthermore, technical health illiteracy is a very prevalent issue among nursing students in Jordan, who do not receive adequate formal technical health literacy education in their nursing schools (Tubaishat & Habiballah, 2016). Moreover, according to a recent Jordanian study, nursing students had a high level of computer anxiety, which impeded the acceptability, adherence, and utility of BS for adequately training the students to manage challenging clinical situations (Akhu-Zaheya et al., 2013). Given the pros and cons of using BS in nursing education and clinical practice, there is no consensus on its feasibility, utility, and acceptability. Therefore, it is essential to explore graduate nursing students' perceptions of the use of BS to target the challenges that impede its utility and enhance its integration into nursing education and practice. To our knowledge, no previous study has examined graduate nursing students'

perceptions of using BS in professional training. Therefore, this study aimed to train student nurses on how to use BS to improve their knowledge, attitudes, practice, and decision-making related to sepsis assessment and management, and then their perceptions were explored.

## Researcher Context

All researchers are interested in education studies, especially nursing education, with different academic levels and clinical experience. Rababa is currently an Associate Professor in the Department of Adult Health Nursing at Jordan University of Science and Technology. Rababa actively carried out consulting activities in the areas of nursing education. Shatha Al-Sabbah and Dania Bani-Hamad are currently clinical instructors in the faculty of nursing at Jordan University of Science and Technology and are interested in educational technology. All researchers were actively engaged in all research processes, including data collection and analysis. This interdisciplinary research collaboration provides deep insight and an extensive analysis of the study's themes. The inspiration to conduct this study stems from the imperative need to shift from traditional teaching to innovative interactive teaching in Jordanian nursing schools. The promise of this study wants to examine graduate nursing students' perceptions of using BS in professional training, thus, enhancing its acceptability, adherence, and utility. We hope that the findings of this study contribute to the development of innovative nursing curricula and improve the quality of nursing education in Jordan.

## Methods

### Design, Setting, and Sample

A qualitative descriptive design (Hennin et al., 2020) was used to explore the impacts of using BS on improving knowledge, attitudes, practice, and decision-making related to sepsis assessment and management from the perspectives of graduate nursing students. This method provides a great level of flexibility in data collection and analysis, contributing to very rich data and an in-depth summary of the diverse perceptions among the students (Creswell & Creswell, 2017). Qualitative approaches have been successfully used in previous studies of students' perceptions of using various teaching strategies (Brook & Kemp, 2021; Youhasan et al., 2022). Therefore, qualitative research was selected as appropriate to investigate the gap in the literature regarding students' perceptions of using BS in nursing education. The qualitative descriptive design allows researchers to describe and explore perceptions that have direct impacts on education settings. According to Bradshaw et al. (2017), the use of the qualitative descriptive design is relevant and crucial for studies exploring the perception of participants about a poorly understood phenomenon. Very little is known regarding factors influencing the utilization of BS in nursing education from the perspectives of Jordanian nursing students; thus, a descriptive qualitative design was selected in comparison to other options for the present study to describe and explore the perceptions of nursing students about the topic. The study sample included graduate nursing students who had been working in ICUs for at least one year at a university hospital in Irbid, Jordan. Twenty participants were conveniently recruited from the selected ICU and interviewed, and their perceptions were analyzed. The participants were aged  $28 \pm 2.3$  years on average. Of the 20 participants, 11 were female, and 9 were male.

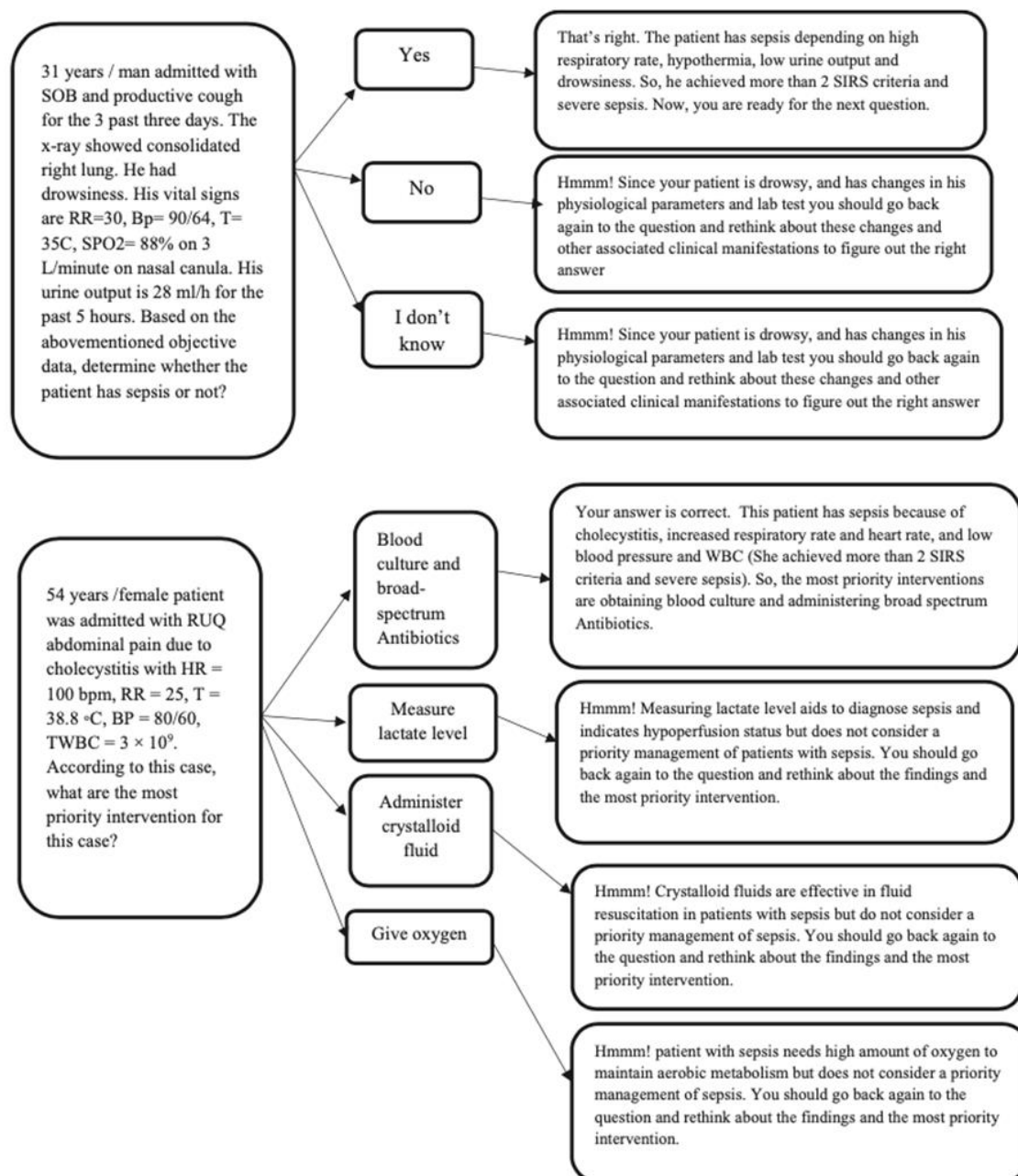
### Data Collection Procedures

Ethical approval from the institutional review board of the university was obtained prior to data collection (IRB# 784-2020). A list of potentially eligible participants was obtained from

the ICU administrative office. All eligible participants were approached by the researchers and requested to provide their written consent to participate in the study.

As an exemplar, the participants were trained on how to use BS to improve their levels of knowledge, attitudes, practice, and modes of decision-making related to sepsis assessment and management. Examples of these are outlined in Figure 1. The training session was delivered by a certified clinical specialist and guided by the learning and analytical decision-making theories (Kovach & Rababa, 2014; Schaefer & Ottley, 2018), which guide the decision-making process related to sepsis assessment and management and provide immediate feedback regarding the selected answers.

**Figure 1**  
*Example of Branching Simulation*



The clinical specialist provided an interactive PowerPoint lecture containing detailed information on sepsis assessment tools and management protocols. After that, the clinical specialist sent the participants a link to the BS and asked them to run it. Then, the participants ran the BS and went through all branches of the simulated case scenarios of sepsis. At the end of the training session, a semi-structured face-to-face interview with each participant was conducted in Arabic by the researchers in a private, quiet place. The average length of the interviews was around 45 minutes. Saturation was achieved when no further information was being obtained from the participants, whereby the interviews were ended.

The participants were asked to respond to four main open-ended questions on their perceptions and opinions regarding the use of BS, its advantages/disadvantages, and its associated stressors. An interview guide (Table 1) was developed by the researcher and used to guide the interviews. The interview questions were piloted on two ICU nurses and modified based on their feedback on question clarity. Any potential misunderstandings were resolved and clarified. The interview guide included questions on the participants' sociodemographic and professional characteristics.

The research assistant audio-taped the interviews and transcribed all audiotapes verbatim in Arabic, resulting in 95 pages, and coded them to maintain the confidentiality and anonymity of the participants' data. Aliases were assigned to the participants to safeguard their confidentiality. Only the researcher could recognize the identity of the participants, and aliases used for all documentation. After transcription in Arabic, two nursing professors who speak both Arabic and English fluently translated the documents into English and verified them independently. Data were saved in a password-secured laptop, and transcripts were stored in a secure cabinet in a locked office that could only be accessed by the researcher.

**Table 1**  
*Interview Guide*

<b>Interview guide</b>
At the beginning of the interview, identify socio-demographic and professional characteristics details of the participating nursing students, including age, gender, marital status, year of experience as a critical care nurse, level of education, and previous sepsis education or training.
(1) What were your experiences with the branching simulation?
(2) What were your perception of the branching simulation as a tool to aid decisions related to early recognition and treatment of sepsis (including its strengths and limitations)?
(3) Compared to traditional training, what were the advantages and disadvantages of branching simulation?
(4) What do you think of the training program and any improvements that could be made?
(5) What are your perceptions of being involved in the study?
(6) Are there other things about practicing BS that have been stressful for you?
(a) Can you share with me any examples of these stressful experiences?
(b) What happened?
(7) In thinking back on your time practicing BS, what has caused you the most stress?

## **Data Analysis**

The thematic analysis approach (Braun & Clarke, 2006) was implemented after reading and re-reading the transcripts to increase understanding of their contents. The thematic analysis was used due to its flexibility and responsiveness in describing unexplored phenomena, highlighting differences and similarities throughout the data set, and identifying, organizing, analyzing, and reporting, themes in depth (Braun & Clarke, 2006). All interview transcripts were split into expressive items and labeled with codes. To identify themes, keywords, and

categories, descriptive codes were assigned to the expressive items. Comparisons between the different codes based on similarities and differences were conducted by both the researcher and research assistant, who sorted these codes into categories and themes. Two qualitative researchers not involved in the data collection process were consulted to double-check the rigor of the analysis process. Then, both the researcher and research assistant examined all categories and provided further explanatory subcategories for each category content. A subsequent meeting was convened between the research team and independent reviewers to discuss any possible discrepancies in data analysis and interpretation. The discrepancies were resolved through internal discussion, with adjudication by a third experienced researcher.

## Results

Four major themes and five subthemes (Table 2) relating to Jordanian graduate nursing students' perceptions of using BS to improve their knowledge, attitudes, practice, and decision-making related to sepsis assessment and management emerged from the analysis. The main themes were (a) BS as a support professional training, (b) BS leads to changes in clinical practice, (c) whether BS is a stressful learning experience, and (d) BS versus traditional lecturing. Further, subthemes under each theme emerged from the analysis.

**Table 2**  
*Study Themes and Subthemes*

Themes	Subtheme
BS as a support to professional training on sepsis assessment and management	Improve Decision-making skills
BS led to changes in Clinical practices and attitudes toward sepsis	Enhance Self-confidence Valid Learning Methods
Is the use of BS a stressful learning experience?	Improve Critical Thinking Being well prepared for sepsis Management Facilitate collaboration and multidisciplinary teamwork
Branching Simulation VS Traditional Lecturing	

### BS as a Support to Professional Training

This theme describes the nursing students' perception of BS as being a support to professional training. The participating nursing students described the impact of BS on facilitating the learning process and improving the learning outcomes, including decision-making and critical thinking skills and self-confidence.

#### *BS is a Valid Learning Method*

The participants highlighted that BS could be a valid interactive learning method that fills a gap in traditional learning methods such as regular lecturing. They described the learning method used in the current ongoing training programs as too boring and ineffective. The main criticism of the current training programs was either the lack of or delayed feedback on the students' treatment decisions. Meanwhile, the participants highlighted that BS is a very structured learning tool that provides a step-by-step guide through the decision-making process



until the correct decision is made: One participant said, “When the BS was being conducted in the training session, we felt that it was more effective and better than the traditional training sessions on sepsis management: the organization is superior, and the feedback on our skills is quicker” (Participant 5). Another participant added, “BS guided me through the complex decision-making process until I reached the correct decision” (Participant 6). These comments indicate that they had perceived the BS to be a valid learning tool.

### ***BS Improves Decision-Making Skills***

Most of the participants perceived that their decision-making skills related to sepsis assessment and management had been enhanced. They described that receiving immediate feedback after selecting the answers to questions had helped them and guided them during the decision-making process until the correct answer had been selected. They believed that the rationale provided for selecting either correct or incorrect answers facilitated the decision-making process and stopped them from otherwise remaining stuck in a trial-and-error approach. One participant said, “Throughout the training session, all patient data involved in the scenario was clear to me when attempting to resolve this complicated situation” (Participant 12). Another participant said, “I’m not so sure I could have resolved it before going through the decision branches. However, I was so pleased to know how the treatment decision-making process unfolded with the delivery of prompt sepsis management” (Participant 7). Further, another student added, “I feel that branching simulations make the decision-making process clearer, which prevents me from being stuck in an ineffective trial-and-error approach. Certainty regarding suspected sepsis clearly plays a huge role in this situation” (Participant 8). Finally, all participants highlighted their interest in placing decision-making skills at the top of their training priorities. This comment indicates that they had perceived the BS training to be an overall positive learning experience.

### ***BS Improves Critical Thinking***

The participants described changes in their critical thinking skills after the BS training, whereby they had been encouraged to focus on critical pieces of information and organize them to form a complete image of the case. This indicated the effectiveness of the BS, as the participants were encouraged to analyze and synthesize their knowledge and not only memorize information. They accomplished this by being actively engaged in the critical thinking process with no interruptions caused by side talks or chatting. All the participants found the immediate feedback and rationale for their selections very helpful. One participant noted, “Before the BS, I would rely on my intuition when assessing patients for sepsis” (Participant 16), and another participant added, “The BS helped me systematize my knowledge related to sepsis assessment before making any treatment decisions” (Participant 17). Finally, another participant said, “I collected all essential information pieces pertaining to the sepsis case and interpreted all cues provided in the case to come up with the most logical inferences” (Participant 18). This finding implies that BS facilitated the critical thinking process to reach a concise inference.

### ***BS Enhances Self-confidence***

The participants perceived that the BS had improved their self-confidence and that it would help reduce their uncertainty regarding suspected sepsis in critical care patients. The participants felt more confident and were able to take more initiative. One participant noted, “Assessment of sepsis is very difficult; however, after the BS, I felt like I had succeeded in

managing the most critical case of sepsis and recognized it would never be as challenging as this” (Participant 1). Another participant added, “After the BS, I felt well-prepared to assess and manage such a life-threatening problem in real life” (Participant 4). Also, another participant said, “The positive learning outcomes of BS could convince nurse managers to incorporate it in ongoing training for critical care nurses, especially junior nurses” (Participant 3).

Most of the participants found that BS could make them more certain about their treatment. They emphasized the lack of sepsis treatment protocols and ongoing training. Accordingly, the participants found the BS to motivate them, as it provides a safe learning environment that allows them to manage challenging clinical situations such as sepsis management. In this regard, one participant said, “BS makes me very willing and confident to care for patients with sepsis” (Participant 20), and another participant added, “Usually, I feel completely unconfident and incompetent, especially when caring for patients with sepsis” (Participant 15). Also, one participant said, “We feel uncomfortable and stressed when caring for real patients with sepsis with no previous training on simulated cases of sepsis” (Participant 17). With the utilization of BS, the participating nursing students manage the stress associated with caring for real challenging patients in the first encounter.

### **BS Leads to Changes in Clinical Practice**

The second theme that emerged was the impact of BS on clinical practice from the perspectives of the participating nurses. They described how BS contribute to the preparation of participating nursing students for sepsis management and facilitate collaboration and multidisciplinary teamwork. The participating nurses also described the stressful experience associated with using BS.

#### ***Being Well-Prepared for Sepsis Management***

For the participants, BS played a significant role in changing their practice, whereby they reported that they would not be assessing and managing sepsis as they did before the BS. The participants reported changes in their level of theoretical and practical preparation, and they also reported feeling more prepared to deal with challenging sepsis cases, as BS unfolds complex multidimensional aspects of sepsis management. One participant said, “The BS helped me be well-prepared for caring for such challenging cases, as it forced me to organize and expand my theoretical and practical base of knowledge related to sepsis assessment and management” (Participant 9). The participants also experienced different feelings during the BS. Despite the pleasant feelings usually experienced during simulation training, the participants expressed feeling focused on reading all pertinent information and making decisions accordingly. One participant said, “We felt focused on reading all pertinent details, as we were enthusiastic about the next level of decision branch” (Participant 8). Another added, “I felt empowered with the branch options, and I was satisfied with the learning experience” (Participant 13). BS provides the students with all possible choices for sepsis management decisions, empowering them to drive their own learning.

#### ***BS Facilitates Collaboration and Multidisciplinary Teamwork***

The participants stated that they were enthusiastic about reading all relevant patient data and making inferences, and they reported their eagerness to read all details pertaining to the case scenario. The participants also reported that they had felt more passionate about sharing those details with the multidisciplinary team, which facilitates communication and

collaboration among team members. This would play an important role in the delivery of prompt sepsis management. One participant said, “I truly believe that creating a strong team involves training and cultivating trust and cohesiveness” (Participant 3). It is imperative for team members to work together to provide safe and optimal care for patients with sepsis. The lesson that the participants learned was that BS helped them reduce clinical errors, improve patient outcomes, and increase patient and staff satisfaction. One participant added, “We think that BS training promotes the integration of teamwork principles to enhance the care and safety of our patients” (Participant 14). Another participant added, “After this training, I believe that our team will be aware of what is going on with all patients in the unit, not just the patients they are assigned to work with for the day” (Participant 17). The participants reported that they were also encouraged to give feedback about the performance of their colleagues. One participant said, “At the end of the training, our team met to discuss the lessons we had learned and what we could do to improve the outcomes of our patients with sepsis” (Participant 20). Another added, “One observation I made about our team was that everyone listened to each other and discussed all patient treatment options” (Participant 4). The participants reported that BS provided them with a common language that facilitated their collaboration and communication.

### ***Is BS a Stressful Learning Experience?***

The participants reported experiencing some stress while using the BS. It was reported that although the preparation for the BS was not stressful, being under direct supervision by the trainer during the BS training was stressful. However, the participants acknowledged that the stress they had experienced had cleared off once they had successfully completed the BS. One participant said, “The use of the BS was easy, and the preparation for it was much easier. However, once I started the training, I was very stressed. This could be related to my eagerness to impress the trainer” (Participant 2). Another participant added, “I think this stressful experience is good because this is how it is in real life, and we have to learn how to manage such situations” (Participant 6). Finally, another participant said, “If we were successful in doing this here, we would be capable of doing so in real life. I prefer to commit mistakes here and feel stressed rather than do so with real patients” (Participant 10). BS provide the student with a unique opportunity to rehearse their caring skills through simulated learning, prior to encountering real patients. However, some participants reported the BS as being stressful overall. Although they all acknowledged its effectiveness in improving their decision-making and critical thinking skills related to sepsis management, they criticized the BS training for imposing a stressful experience on their busy work schedules. One participant said, “Although we understood the case scenarios, it was stressful to go through all of the decision branches” (Participant 11), and another added, “I thought that the BS would be a fun experience” (Participant 12).

### **Branching Simulation VS Traditional Lecturing**

Most of the participants emphasized the significance of training prior to using the BS and thus preferred being trained using both BS and traditional lecturing. They recommended using BS as a complement training strategy rather than an alternative to traditional lecturing. One participant said, “Nurse managers should incorporate BS in the current ongoing training programs that rely mainly on traditional lecturing” (Participant 18), and another added, “We must do more training on sepsis assessment and management utilizing both BS and traditional lecturing, even if it requires additional working time” (Participant 19). However, the participants recognized that BS is superior to traditional lecturing in improving their decision-

making skills related to sepsis management. Meanwhile, some participants identified BS as being less formal than traditional lecturing, probably due to its novelty. One participant said, “I prefer to be trained by a regular lecture with PowerPoint slides presented in front of all nurses rather than a self-directed BS” (Participant 11).

In comparing the BS with traditional lecturing, all the participants highlighted that the major difference was that the BS provided them with immediate feedback after selecting a choice. One participant said, “The main reason we are motivated to use the BS is that it provides immediate feedback, and it allows me to know what I had to assess for immediately after the training session” (Participant 20). The last issue associated with the use of BS was the limitations in computer literacy among some of the participants. One participant highlighted, “I belong to the classic school where we only use paper and pen to study. I don’t know to deal with computers, especially when I encounter technical issues” (Participant P10). However, this issue should not limit the use of BS, as the participants highlighted many advantages to its use.

## **Discussion**

The present study explored graduate nursing students’ perceptions of using BS in professional training on an exemplar of a sepsis simulated case. It was found that BS would be beneficial in clinical practice, as it improves nursing students’ self-confidence in caring for real challenging cases such as sepsis cases. Further, BS was found to provide students with a safe learning environment in which they can commit and correct their mistakes when making treatment decisions. The participants also perceived BS as a valid learning tool with a structured decision-making process that would positively impact their clinical practice.

BS offers a potential learning environment for nurses to acquire and practice decision-making skills related to challenging patient situations (Rababa & Masha'al, 2020). BS would be a successful tool for change of not only the current assessment and management protocols of sepsis but also the education system in nursing schools (Rababa, 2021). The data derived from our study support the findings of previous studies and emphasizes immediate learning and analytical decision theories (Kovach & Rababa, 2014; Schaefer & Ottley, 2018). A previous study hypothesized that by enhancing nurses’ self-confidence and treatment certainty within their clinical practice, they would be more capable of conducting effective assessment and providing prompt management (Kovach & Rababa, 2014). Our findings indicated that BS is a very effective learning experience that improves decision-making and critical thinking skills. By practicing BS, the nurses feel that they are actively involved and very experienced healthcare professionals (Kovach & Rababa, 2014).

BS led to changes in the nurses’ sepsis-related clinical practice by impacting their levels of theoretical and practical preparation. With the BS, the nurses were aware of the treatment objectives and had high levels of decision-making certainty (Dabney et al., 2020). Decision-making certainty and assertiveness in learning are factors that encourage nurses to be actively involved in the decision-making process (Rababa & Al-Rawashdeh, 2021). Another change in clinical practice induced by BS was the impact it had on collaboration and multidisciplinary teamwork.

BS has a great role to play in improving collaboration and multidisciplinary teamwork because it employs a reproducible environment for continuing education and evidence-based practice (Kovach & Rababa, 2014). Nursing education needs to be seen as a continuum that is always changing and up to date (Vázquez-Calatayud et al., 2021). With evidence-based practice and continuing education, collaboration would come second nature regarding the educational aspect as all nurses would at least be given the tools needed to collaborate with their colleagues appropriately (McLoughlin et al., 2018). Moreover, BS facilitates

multidisciplinary communication, which is the most important element for collaboration and teamwork (Dabney et al., 2020).

Although BS provides a safe environment for nurses to assess and manage simulated case scenarios where there is still a chance of committing mistakes and learning from these mistakes, this learning environment has been revealed to be associated with some stressful experiences. For example, BS is difficult to incorporate given the busy work schedules and high patient/nurse ratios associated with nursing practice. Further, computer illiteracy and anxiety (Tubaishat & Habiballah, 2016) may explain some of the nurses' experienced stress associated with the use of BS. Thus, the development and application of BS should be done with caution, and current learning environments and technological facilities need to be tailored to nurses' learning needs. Also, a possible improvement would be to enhance nurses' computer literacy in future studies.

Nursing schools in Jordan rely mainly on traditional lecturing, which is associated with rapid information processing as compared to BS, which is associated with more analytical thought processes (Rababa, 2021). Discussions on the empirical properties of BS have emphasized two main features of this learning tool: immediate feedback and an analytical thought process (Bateman et al., 2012). Traditional lecturing either provides delayed feedback or does not provide it at all (Rababa, 2021). With a step-by-step decision process, BS could provide nurses with immediate feedback on their selection of choices (Rababa & Masha'al, 2020). BS encourages nurses to use an analytical thought process when trying to solve challenging health problems by separating the entire problem into its essential elements and then analyzing these elements and their relations with each other (Rababa & Al-Rawashdeh, 2021).

## Limitations

The present study has some limitations. First, this study was conducted in a single setting and on a homogenous sample. Second, the lack of a quantitative experimental research design that would more objectively disentangle cause-effect mechanisms. Third, the blinded qualitative data obtained were not shared with the participants, which would have enhanced the validity of the findings as the participants would have been able to confirm that their perceptions had been accurately reported.

## Conclusion

The participating graduate nursing students perceived BS to be a valid learning tool that can improve their critical thinking and decision-making skills, self-confidence, practical and theoretical preparation, and multidisciplinary teamwork and collaboration. The BS provided the students with a safe learning environment in which there was room for committing mistakes and learning from them without putting the lives and health of real patients at risk. The data analysis emphasized two main features of BS that make it superior to traditional training, namely immediate feedback, and analytical thought process. The participants found that the learning experience associated with the use of BS would positively impact their clinical practices of sepsis management. However, they acknowledged some associated challenges or stressors that may be attributed to their technology illiteracy and anxiety. Thus, future research is needed to examine the effectiveness of incorporating BS in nursing practice and education.

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