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Original Article

Realistic simulation case scenario as a vertical integration teaching tool for medical students: A mixed methods study

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المخلص

أهداف البحث: أصبح التعلم الواقعي القائم على المحاكاة مؤخرا جزءا لا يتجزأ من التعليم الطبي، والذي يوفر العديد من المزايا إذا تم تطبيقه بشكل فعال. هدفت هذه الدراسة إلى تطوير والتحقق من صحة سيناريو حالة محاكاة واقعية كأداة تعليمية جديدة لطلاب الطب في المرحلة قبل السريرية. علاوة على ذلك، كنا نهدف إلى تقييم تصور الطلاب باستخدام هذه الأداة كإستراتيجية تدريس، بالإضافة إلى الحصول على فهم متعمق لوجهات نظر الطلاب.

طرق البحث: استخدمنا نهج الأساليب المختلطة لاستكشاف كيفية تطور التفكير السريري من خلال سيناريو حالة محاكاة واقعية والتحقق من صحتها. أجريت هذه الدراسة، التي شملت 50 طالبا في السنة الثالثة من كلية الطب، في كلية الطب، جامعة دار العلوم، المملكة العربية السعودية بين نوفمبر 2021 وفبراير 2022.

النتائج: كان معظم المشاركين (94 ٪) راضين عن طريقة سيناريو حالة المحاكاة الواقعية، وأفاد 92 ٪ من المشاركين أن سيناريو حالة المحاكاة الواقعية أكثر فعالية في تحقيق أهداف التعلم. تم الإبلاغ عن العديد من مزايا سيناريو حالة المحاكاة الواقعية مثل إعطاء أفضل معرفة واقعية لإدارة الرعاية الحرجة، وتشجيع مشاركة الطلاب في عملية التعلم، وتعزيز مهارات التعامل مع الآخرين وحل المشكلات.

الاستنتاجات: سيناريو حالة المحاكاة الواقعية هو نهج تعليمي فعال وديناميكي يساعد في تعزيز المعرفة مع تأثير كبير على عواطف الطلاب وقدراتهم المعرفية.

الكلمات المفتاحية: سيناريو الحالة؛ مهارة إكلينيكية؛ طالب طب؛ دراسة طريقة مختلطة؛ محاكاة واقعية

Abstract

Realistic simulation-based learning has recently become an integral part of medical education and can provide several advantages if applied effectively. This study aimed to develop and validate a realistic simulation case scenario (RSCS) as a novel teaching tool for preclinical medical students. Furthermore, we aimed to evaluate student perception of this tool as a teaching strategy, as well as to acquire an in-depth understanding of student perspectives. We employed the mixed methods approach to explore how clinical reasoning develops through a validated RSCS. This study, which included 50 third-year medical students, was conducted at the College of Medicine, Dar Al Uloom University, KSA between November 2021 and February 2022. Most of the participants (94%) were satisfied with the RSCS method and 92% of the participants reported RSCS as more effective in terms of achieving learning objectives. Many

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advantages of RSCS have been reported, including the provision of realistic knowledge relating to critical care management, encouraging student participation in the learning process, and enhancing interpersonal and problem-solving skills. In conclusion, RSCS is an effective and dynamic teaching approach that aids in knowledge consolidation with a significant impact on the emotions and cognitive abilities of students.

Keywords: Case scenario; Clinical skill; Medical student; Mixed method study; Realistic simulation

Introduction

Almost all teaching institutions have experienced a shift from teacher-centered to student-centered learning approaches; the same is true for medical schools. Apart from interactive lecturing, small group teaching and clinical skill sessions play a pivotal role in medical education. Realistic simulation-based learning, an interactive teaching and learning strategy, has recently become an integral aspect of healthcare education that offers an alternative approach to the traditional style that focuses on the learning needs of the students.[26] Realistic simulation-based learning has several advantages, one of which is that it helps medical students bridge the theory-practical gap by enabling them to distinguish between "knowing" and "doing". This influences outcomes in the clinical setting. In addition, this practice helps to enhance the empowerment and self-confidence of students as they build decision-making skills and self-learning capacities.[16] An extensive range of behaviors and skills can be taught, learned, assessed, and reflected upon in a learner-centered way using simulation-based learning.[1]

Clinical reasoning mainly involves the use of knowledge and skills to reach a diagnosis and decide upon a management plan that is personalized for each patient.[20] With the recent trend toward vertical integration in the medical curriculum, medical students are now being exposed to various types of clinical skills as early as their first year. The clinical component continues to increase in the following years as per the wedge design of integration. However, in the early years of the medical curriculum, clinical teaching is limited to basic clinical skills which needs to be more engaging and focused, particularly in a college setting when students are not exposed to patients. Subsequently, medical students frequently express excessive anxiety and low confidence in their clinical skills.[12] Moreover, clinical teachers have also reported their concerns with regards to the preparation of preclinical medical students for the clinical phase.[27] Another important point is that impactful and well-designed scenarios form the mainstay for teachers to address learning objectives and deliver a significant learning experience for medical students. With this in mind, we sought to develop and validate a realistic simulation case scenario (RSCS) as a novel teaching tool for improving the clinical reasoning skills of preclinical medical students. This RSCS includes practicing free unguided clinical reasoning together with applying clinical skills to preclinical medical students. We also aimed to assess student perception and overall satisfaction with regards to the RSCS as a teaching approach, as well as to acquire an in-depth understanding of student perspectives.

Materials and Methods

Research design

This is an interventional, mixed-methods study with a convenient sampling technique. Both quantitative and qualitative research methods were used to assess student perception and to explore how clinical reasoning develops through realistic simulation-based problems in a comprehensive manner. The rational of using the mixed methods design is that quantitative data provides insights about student perceptions and overall satisfaction with regards to the RSCS as a novel teaching tool. On the other hand, analysis of the qualitative data provided a deeper understanding of the quantitative findings and a more in-depth explanation of the perspectives of participants.

Study setting

The current study was conducted between November 2021 and February 2022 at the Clinical Skills and Simulation Laboratories (CSSL) at the College of Medicine, Dar Al Uloom University (DAU), KSA. The CSSL is equipped with appropriate audio-visual equipment that is suitable to imitate the simulated setting of an emergency department at a hospital. The curriculum in the college of medicine, DAU, follows the vertical integration model which is conducted over six years. This curriculum consists of three phases: phase I (preparatory, first year), phase II (preclinical, second and third years), and phase III (clinical, fourth, fifth, and sixth years). Clinical sciences are incorporated in the preclinical phase (phase II) as problem-based learning and clinical skills sessions that focus on basic clinical skills such as history taking, clinical examination, and certain clinical skills.

Participants and sampling strategy

In this approach, the facilitator's team was diversified by the inclusion of some facilitators who were experienced tutors in the clinical department who regularly taught students clinical skills across the years. The second element is non-clinical facilitators who are academics working in the basic medical sciences department. Both clinical and academic tutors have solid experience in problem-based learning modalities. However, both types of tutors received training on the format of the session, how to facilitate this case, clinical skills education and assessment, and how to provide feedback to students. In addition, an experienced simulation patient was recruited to enhance more authentic practice of the scenario. Despite having good experience in acting for educational purposes, the simulated patient underwent training on the scenario to provide a consistent patient

experience. Of note, no informed consent was needed; hence the simulated patient was not exposed to any risk or burden.

A total of 50 third-year medical students participated in this study and were approached using convenient sampling. Students were included if they were undergraduate medical students in their third year at the College of Medicine DAU, had completed the preparatory phase, and were willing to sign the informed consent form. All students from the clinical (phase III) and the preparatory (phase I) phases were excluded. The recruited students were contacted personally and electronically *via* e-mail invitations.

Ethical considerations

After obtaining the ethical approval, each student was informed that they could refuse to participate or to opt out at any moment of the study. There was no financial incentive for participants. In addition, all participants signed an informed consent form before the beginning of the study. The findings of this study were treated anonymously.

Research instruments

The scenario

The research team suggested and developed topics for the RSCS including myocardial infarction, thyrotoxicosis storm, and COVID-19 cases. Myocardial infarction was the final selection based on discussion and group consensus, considering the preparedness of both the students and the CSSL; this ensured the participation of a greater number of students. The case scenario was validated by a panel of three clinical specialists/physicians who evaluated the case independently. The raters used a Likert rating scale to assess the pertinence, relevance, coherence, clarity, and sufficiency of the content proposed in the clinical case. The response options were as follows: (1) fails to meet the criteria; (2) shows a low level of compliance; (3) shows a moderate level of compliance; and (4) shows a high level of compliance.[14] The reviewers also ensured that the case helped students to practice free unguided clinical reasoning along with the incorporation of knowledge, and the application of clinical skills.

According to comments made by the reviewers and researchers, modifications were made to the learning objectives to be accomplished during the realistic simulation session, the information provided to the students before interacting in the simulated environment, and the organization of the data exposed in the simulated case to avoid distractions that could interfere with student practice. Finally, a pilot study was conducted on 15 medical students who were excluded from the study sample. This was applied to evaluate the clarity and applicability of the tool; modifications were incorporated as necessary.

Harvey cardio-pulmonary simulator

In the current study, we employed "Harvey", a life-sized mannequin available at our CSSL, which gives the user the opportunity to study various cardiac conditions and practice bedside examination techniques under realistic conditions (GCRME, Miami, Model Number (UM2013)). This mannequin provides users with a realistic simulation of 30 cardiovascular conditions (two normal and 28 cardiovascular diseases), which help medical students to develop and improve their diagnostic skills in the field of cardiac care. It is worth noting that Harvey is placed in a special area which is connected with a control room where the facilitators can follow the activity of the students without being noticed.

Student perception questionnaire

In the current study, we employed an established questionnaire[2] that had been modified slightly and validated by two medical education experts. This questionnaire focused on the students' perception of using the RSCS as a novel teaching strategy and their overall satisfaction. The questionnaire consisted of two parts: the first part included demographic data, and the second part included student perceptions (13 closed-ended questions and 2 open-ended questions). Responses to closed-ended questions were rated on a five-point Likert scale, with 1 representing strongly disagree and 5 representing strongly agree. The employed questionnaire was designed in Google forms and the link was distributed to students *via* email after the educational session. Before running the actual study, a pilot test was conducted as the questionnaire was randomly distributed to 15 students to assess the clarity of the wording and the structure of items. Two items were restructured based on feedback from the pilot study participants. Cronbach's alpha was then used to determine data reliability.[8]

Guidance sheets for students and facilitators

The research team prepared many guiding sheets to be used during the RSCS session. A history taking and examination sheet was prepared and provided to be filled out by the students as the case progressed. A facilitator guiding sheet included the case stem as well as the patient/family history, vital signs, physical examination aspects, and treatment (s) with expected outcomes. From this information, the mannequin could be made to "come to life" through the facilitator's actions and respond appropriately to the situation. In addition, a "Done", "Partially done", "Not done" validated checklist for questions given during history taking and the skills performed during the examination was provided for the facilitator to complete while observing the students. Items that needed to be in the room were listed and provided (in some cases by photographs), thus limiting exposed supplies to minimize student distraction and error.

Pre-class preparation materials for students

Some materials were prepared and sent to the students before the simulation session and after completion of the registration process; this included two videos with PowerPoint presentations that briefly highlighted the epidemiology and management of cardiovascular system diseases. The student's active learning was ensured by indirect monitoring through http://edpuzzle.com.[10] This active learning was mandatory for students to participate in educational studies.

Intervention and data collection

According to the student's preferences and in alignment with the timetable of the College of Medicine, DAU, the session timings were determined on the most appropriate,

non-stressful days. The students were assigned into small groups (a maximum of 5 per group). One facilitator guided each group and each session was 60 min long.

The process was divided into 4 phases: pre-simulation phase, simulation phase, debriefing phase, and feedback phase (Figure 1).

Pre-simulation phase: (10 min)

Students received instructions and guiding information concerning the RSCS session structure with a full explanation of what will be expected from them. A clear statement that this exercise not only contributed to the grades awarded for the clinical skill lab was given to the students. Informed consent was obtained from all participants, with students having the right to refuse to participate or withdraw from participation in the evaluation at any time with no penalty.

The simulation phase: (30 min)

The case scenarios were originally designed from the clinical skills taught in the preclinical years mimicking a real-world clinical situation, and subsequently, the results can then be applied to the actual clinical practice. Student groups were requested to manage the case and complete the Patient History Taking and Examination sheet provided, which included history taking, examination findings, investigations required and their interpretation, differential diagnosis, final diagnosis, and treatment.

The clinical skills practice of the participating students was assessed by the facilitator in the control using a trained simulated patient for history taking skills, whereas Harvey the cardiopulmonary simulator mannequin was used for cardiac examination skills. The students were evaluated based on their ability to perform comprehensive history taking and physical examination, based on a validated checklist as well as their communication skills with the simulated patient. On the other hand, an unguided student roundtable discussion was conducted to explore their clinical reasoning skills in terms of requesting and interpreting relevant investigations, reaching a valid differential diagnosis, and prescribing a treatment plan including patient education steps.

The debriefing phase (10 min)

This phase allowed for dialog between students and the session's facilitator. Debriefing focused on the cognitive process involved in problem identification, based on the patient chart completed by students during the simulation phase, the implementation of the management guidelines, and the ability of the students to apply the techniques such as examination. Additionally, during this phase, the students were able to reflect on their knowledge acquisition, the learning process, how they felt about their performance, and if they could perform better. All participant responses to the debriefing questions were recorded and analyzed later by two independent researchers to uncover emerging themes.

Feedback (10 min)

After the whole process, students who actively engaged in the session were given the link to the Google form for the questionnaire gathering data on their perceptions of the RSCS. Upon completion of the questionnaire, the participants were granted certificates of appreciation as a simple reward for their dedication.

Data analysis

All statistical analyses of the quantitative data was conducted using the Statistical Package for the Social Science (SPSS) software version 26 (IBM Corp., Armonk, N.Y., USA). Numerical data are summarized as means and Standard Deviations (SD), while categorical data are presented as numbers and proportions. We also used the Friedman rank test, a non-parametric test that helps to analyze ordered data after identifying whether or not there is a pattern in ratings provided by the respondents. Friedman rank test used the mean score of each statement to rank the student perceptions of RSCS as a teaching tool. The level of significance was set at 0.05 for all tests.

For qualitative data, the responses to the open-ended questions in the satisfaction survey together with the recorded answers to the debriefing questions were analyzed by two independent authors. The qualitative analysis was then reviewed and discussed by all members of the research team to ensure credibility and trustworthiness until they reached a consensus. Data were coded manually to detect the emerging themes using inductive content analysis. Finally, all members of the research team agreed on the emergent themes.

Results

In the current study, 50 third-year medical students agreed to participate; 36 (72%) were female and 14 (28%) were male students. Among the total number of participants, 6 (12%) had prior experience working in such a scenario being already a graduate of nursing or a respiratory therapist but as an assistant. Most of the participants (44; 88%) were new to simulation/scenario-based teaching but were exposed to conventional clinical skill teaching during their basic sciences years.

Results arising from quantitative data

The frequency and percentage were calculated for each of the statements rated on a scale of five-point scale, as shown in Table 1. Our results suggested that a significant number (62%, n = 31) of the participants strongly agreed that RSCS is more effective in achieving learning objectives. This number increased to 92% (n = 46) when 30% (n = 15) of our participants agreed on this. Furthermore, RSCS gives the best realistic knowledge of critical care management was the opinion of 90% (n = 45) of participants and the majority of participants (94%, n = 47) considered that RSCS is more exciting and enjoyable than traditional methods. Moreover, 88% (n = 44) of the participants thought that RSCS encourages teamworking between students and helps them to acquire interpersonal skills and encourage teamworking skills. More than 94%

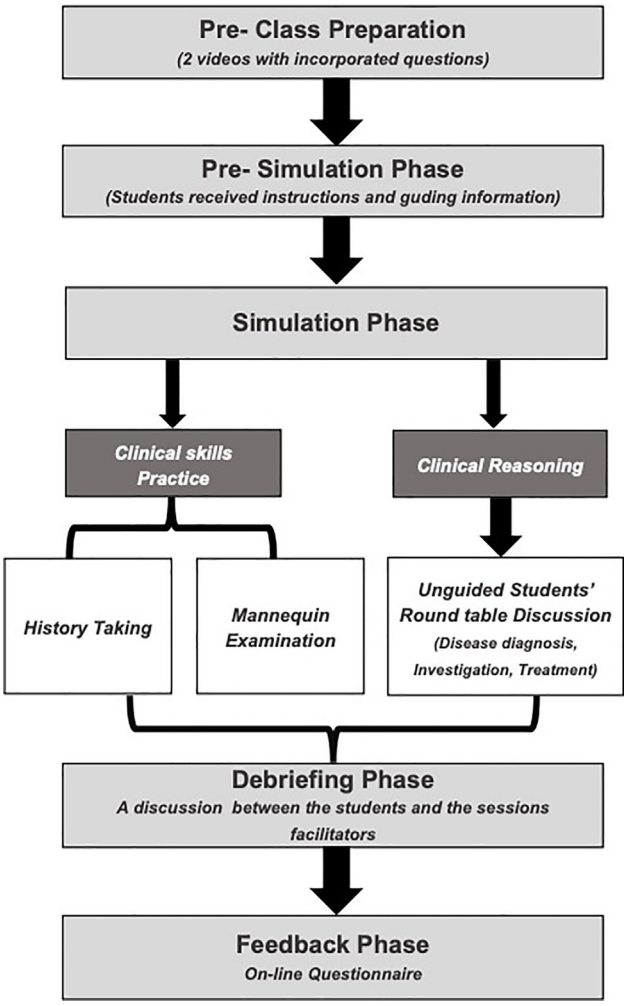

Figure 1: Flowchart showing the different phases of the study.

(n = 47) of participants felt motivated to do the best work by RSCS. Overall, most of the participants (94%, n = 47) were satisfied with the RSCS as a learning tool.

Next, we employed the Friedman rank test, a non-parametric test that uses the mean score of each statement to rank the perception of students related to the advantages of RSCS as a teaching tool. Our results revealed that the first ranked statement was "RSCS is more exciting and enjoyable than traditional methods" with a mean score of 4.66. The second and third-ranked were "Overall, I was satisfied with the RSCS as a learning method" with a mean score of 4.54, and "RSCS encourages students to participate in the learning process" with a mean score of 4.46. However, a low mean score of 2.46 was evident when the students were asked whether the RSCS produced a lot of pressure on them (Table 2).

Results arising from qualitative data

Four themes emerged from the content analysis of the open-ended questions and the student responses to the debriefing questions.

Theme 1: RSCS as a novel learning experience

Many of the participants showed high levels of enthusiasm about their involvement in this educational activity. They believed it was a good method that was different from the conventional approach of teaching skills laboratories as it was more engaging and made learning more enjoyable. One of the students said:

> *"Compared to what we usually do in the skill lab sessions, that was a step up."*
>
> *Another student reported: "… … it was exciting to be engaged with my colleagues, the supervisor, and the simulated patient, it was so much fun."*

Theme 2: RSCS positively affected cognitive skills and student emotions

Many participants reported that the RSCS had many positive impacts on their skills especially in terms of communication and problem-solving skills. Interestingly, the students reported how they felt empowered and confident that they could provide medical service independently. Some of the students reported that this experience also positively affected their communication, problem-solving, and leadership skills.

> *"Having this experience of being prepared, working as a team, and acting like a real doctor was quite pleasant. All of this increased my confidence in my abilities to handle situations in the future."*
>
> Another student commented, *"… during this session, many skills have been polished, particularly how we communicate with each other and with the simulated patients, and how we all worked together as a group to solve the problems we faced during this scenario."*

Theme 3: factors affecting the success of the RSCS session

The majority of the participants recognized several factors that positively affected the success of the RSCS session. These factors included doing this work in small groups, most of the students being familiar with each other and mostly having the same knowledge and experience, the familiarity of the students with the case as it was part of their curriculum, using well-trained simulated patients which ensuring that the case was realistic, and student readiness as they received preparation materials a few days before the session. They also highlighted the important role of the facilitator in supporting and supervising the sessions and giving immediate feedback at the end of the session. Some students reported the following:

> *"Working in a small group was an advantage of this session."*
>
> *"… it was very important to have a feedback session right after the case ended, where we could freely talk about how we felt and what we thought while getting feedback from the session facilitator."*
>
> *"Using a control room with two-way glass where the facilitator could follow us but we couldn't see him was a*

Table 1: The perception of participants with regards to the realistic simulation case scenario (RSCS) as a teaching tool.

Domain	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. RSCS is more effective in achieving learning objectives	31 (62.0%)	15 (30.0%)	1 (2.0%)	0	3 (6.0%)
2. RSCS gives the best realistic knowledge of critical care management	24 (48.0%)	21 (42.0%)	2 (4.0%)	0	3 (6.0%)
3. RSCS encourages students to participate in the learning process	32 (64.0%)	15 (30.0%)	00	00	3 (6.0%)
4. RSCS is more exciting and enjoyable than traditional methods	42 (84.0%)	5 (10.0%)	00	00	3 (6.0%)
5. RSCS encourages students teamwork and acquires interpersonal skills	31 (62.0%)	13 (26.0%)	3 (6.0%)	00	3 (6.0%)
6. RSCS has helped me to develop problem-solving skills related to critical care management.	26 (52.0%)	19 (38.0%)	2 (4.0%)	3 (6.0%)	0
7. RSCS motivated me to do my best work.	31 (62.0%)	16 (32.0%)	00	00	3 (6.0%)
8. RSCS has improved my analytic skills.	20 (40.0%)	25 (50.0%)	2 (4.0%)	00	3 (6.0%)
9. RSCS has promoted my ability to work as a team member.	30 (60.0%)	14 (28.0%)	1 (2.0%)	2 (4.0%)	3 (6.0%)
10. RSCS produced a lot of pressure on me as a student	3 (6.0%)	5 (10.0%)	10 (20.0%)	26 (52.0%)	6 (12.0%)
11. RSCS developed my planning ability in work	19 (38.0%)	24 (48.0%)	4 (8.0%)	0	3 (6.0%)
12. RSCS stimulated us to search for various resources by ourselves	14 (28.0%)	21 (42.0%)	10 (20.0%)	2 (4.0%)	3 (6.0%)
13. Overall, I was satisfied with the RSCS as a learning method.	36 (72.0%)	11 (22.0%)	00	00	3 (6.0%)

RSCS: realistic simulation case scenario.

Table 2: Ranking the perception of students with regards to advantages of RSCS as a teaching tool using the Friedman rank test.

Domain	Mean Score	Rank Score
RSCS is more exciting and enjoyable than traditional methods	4.66	1
Overall, I was satisfied with the RSCS as a learning method.	4.54	2
RSCS encourages students to participate in the learning process	4.46	3
RSCS motivated me to do my best work.	4.44	4
RSCS is more effective in achieving learning objectives	4.42	5
RSCS encourages students teamwork and acquires interpersonal skills	4.38	6
RSCS has promoted my ability to work as a team member.	4.32	7
RSCS has helped me to develop problem-solving skills related to critical care management.	4.3	8
RSCS gives the best realistic knowledge of critical care management	4.26	9
RSCS has improved my analytic skills.	4.18	10
RSCS developed my planning ability in work	4.12	11
RSCS stimulated us to search for various resources by ourselves	3.82	12
RSCS produced a lot of pressure on me as a student	2.46	13

RSCS: realistic simulation case scenario.

great point since it provided a sense of being unsupervised and fully accountable for what we were doing."

"Having the simulated patient gave the skill lab session a more realistic sense."

Theme 4: suggestions from students to improve the RSCS sessions

Finally, we asked the students about their suggestions to improve the RSCS sessions. One suggestion was to send the preparation material a few days earlier so that they could be well prepared. Another suggestion was to include a training session for the students on how this activity should be conducted. Others recommended increasing the time assigned for the session.

"I enjoy how they provide us the materials to read before the session, but it would be more helpful if they delivered it a few days earlier."

"Everything went great for me, however I think that giving each component of the session more time can improve my performance."

Discussion

Currently, most medical schools are shifting their learning strategy from teacher-oriented to student-oriented teaching methods. Implementing simulation-based training in the early years of the medical curriculum would help

students to improve their interpersonal, communication, and problem-solving skills. Moreover, this would help to integrate their knowledge from multidisciplinary topics as well as helping them to assess their own reactions and capabilities. Although early clinical exposure for undergraduate medical students has many advantages, preclinical medical students frequently express excessive anxiety and low confidence in their clinical skills. In addition, clinical instructors have expressed concerns about the clinical readiness of preclinical students. Hence, the context of this study aimed to improve student learning opportunities by developing and validating a realistic simulation case scenario (RSCS) as a tool for improving the clinical reasoning skills of preclinical medical students. Furthermore, we also aimed to evaluate the perception and overall satisfaction of students with regards to RSCS as a teaching strategy.

The case scenarios in the current study were designed to cover the clinical skills taught in the preclinical years and to mimic a real-world clinical situation; subsequently, the results can be applied to actual clinical practice. This study included a convenient sample of 50 students who are currently enrolled in the third year (preclinical phase) at the College of Medicine, DAU, KSA. Overall, most of our study participants were satisfied with the RSCS teaching approach. Our analysis revealed many advantages of the RSCS strategy such as being more effective in achieving learning objectives in comparison to the traditional teaching of clinical skills, giving the best realistic knowledge of critical care management, encouraging students to participate in the learning process, encouraging' teamwork and the acquisition of interpersonal skills, and motivating the students to do their best work. In addition, RSCS helps the students to develop problem-solving skills related to critical care management as recorded in the student perception questionnaire. In agreement with our results from both quantitative and qualitative data, many previous studies have reported that scenario-based education expands student knowledge and awareness and improves their learning abilities and analytic skills.[2,9] Another study, by Hudson and Ozsevgec, investigated the effectiveness of simulation-based learning in learning and overcoming student misconceptions and also found that simulation-based learning strategies had a considerably positive effect on the achievement of students.[13,19] Our results are also consistent with those of Amorim et al., who reported that students perceived realistic simulation in a pediatric emergency as an effective teaching approach.[4] Furthermore, previous studies showed that simulation-based learning can improve the communication skills, patient teaching, and teamwork of nursing students.[3,5,21] Interestingly, Battista reported that students made sense of the clinical situation presented in the scenario by reflexively integrating the use of physical clinical tools, social interactions, and the performance of structured interventions.[5] Other investigators reported a lack of communication skills among newly graduated nurses when facing real patients or their caregivers. After three months of the scenario based simulation training program, a significant improvement was noticed in the communication skills of the intervention group.[15] It is clear from the study of Sonmiz and Yeldirim that nurses reported having difficulty with starting peripheral intravenous catheterization, aspiration, and the use of medical devices during the first months of employment, thus indicating the importance of practice before real-life application in hospitals.[24] Finally, another study demonstrated that simulation-based learning was a dynamic learning strategy for critical care nursing students as it enhanced appraisal skills and learning abilities.[2]

In the present study, the Freidman rank test showed that the first ranked statement among the stated advantages of the RSCS, was "RSCS is more exciting and enjoyable than traditional methods". This is also supported by the qualitative analysis of student responses in the current study. These results are consistent with previous studies which reported that simulation scenarios were a motive for most nursing students with a valuable learning experience and clinical skills.[7,18] In contrast, a few students (8%) from those enrolled in our study reported the RSCS created a lot of pressure for them. This can be explained by the fact that many students are worried about judgment from their peers and others may be low achievers. However, this feeling can be markedly reduced by the pre-simulation briefing time. This is supported by the findings of Rudolf et al., who noted that psychological safety from previous experience is important and the debriefing phase can provide this safety.[22]

Another important finding from our qualitative analyses was the potential factors impacting student performance during the RSCS sessions as reported by the enrolled participants. Among the factors reported by the participating students in this research were working in small groups, the familiarity of the students with the case, employing well-trained simulated patients, and student preparation before the session. Many previous studies support our current findings as they reported comparable pedagogical factors that affect simulation-based learning.[23,25] Our students also highlighted the important role of the facilitator in supporting and supervising the sessions, as well as providing immediate feedback at the end of the session. This is consistent with Madsgaard et al. who reported the crucial role of the facilitator as an effective component of learning in simulation.[17] Finally, despite the fact that most of the participating students were satisfied with the new experience of RSCS as a learning tool, some of the enrolled students made a few suggestions for improving this educational activity session such as student training before the RSCS activity and increasing the time allotted for the simulation session. Previous research has consistently shown that arriving prepared for the clinical skills education session increases student involvement and helps to enhance student skills.[6,11,28]

One of the strengths of our research is the use of a mixed-methods design which aids in the exploration of student perceptions as well as a better understanding of student interpretations with more detailed evidence. In addition, the results of this study were informative about the RSCS as a novel tool that enhances clinical reasoning skills for preclinical medical students. One potential limitation of the current study may be attributed to the fact that it only applied to a group of students from the same academic year

and covered one case scenario. Therefore, further research need to focus on various academic years utilizing many case studies.

In conclusion, our findings clearly emphasized that the application of RSCS for preclinical medical students can effectively tackle the known limitations of the traditional skills laboratory teaching approach. RSCS can be conducted easily and significantly improves the clinical reasoning of preclinical medical students as it helps students consolidate knowledge and incorporate clinical skills. Based on the findings of our study, we strongly recommend the implementation of RSCS as a teaching tool in the medical curriculum for preclinical medical students.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

This research was approved by The Institutional Review Board of the College of Medicine, DAU (IRB # Pro20120005, December 2021). All participants signed an informed consent form before the beginning of the study.

Authors' contributions

Conceptualization and study design: all authors; data collection: BM, M.K., and EY, analysis and interpretation of results: all authors; draft manuscript preparation, all authors; review and editing, M.K; N.M. and E.Y.; All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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Data availability statement

The data that support the findings of this study are available from the corresponding author [EY] upon reasonable request.

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