




Orientation of Healthcare Educators Towards Using an Effective Medical Simulation-Based Learning: A Q-Methodology Study

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Purpose: This study explores the healthcare educators' orientations about medical simulation in clinical skills training —its benefits, needs, challenges, and implications for proper implementation and integration into curricula.

Methods: The study used a Q-sort technique, allowing quantitative and qualitative representation of the participants' orientations and was conducted at King Saud bin Abdulaziz University for Health Sciences in Riyadh, Saudi Arabia. A total of 22 healthcare educators from different roles were included. Participants pre-sorted into three categories and then ranked statements related to medical simulation, by level of agreement, and they answered open-ended and demographic questions. Data was uploaded to Ken-Q Analysis application to conduct Q-factor analysis.

Results: A total of 22 healthcare educators participated in the study. Q-factor analysis was performed with principal component analysis and varimax rotation, identifying three factors. Most educators shared a similar orientation regarding the benefits of using simulation-based learning. Most participants considered medical simulation a simple, effortless, and beneficial method of learning. However, challenges in scheduling sessions and obtaining the necessary resources, such as human resources and funds, and lack of training had a negative impact on some participants' motivation to use medical simulation.

Conclusion: Healthcare educators shed light on the influence of multiple factors on using medical simulation. The possibility for students to learn practical and clinical skills was a leading factor. Financial resources, funds, and faculty training were identified as challenges and needs. It is important for institutions and leaders to be aware of the variations in faculty perceptions and to provide resources and training to improve the current use of medical simulation.

Keywords: medical education, by-person factor analysis, simulation-based training, educators' perception, Q-sort study

Introduction

Simulation is a practical methodology for creating a learning-by-imitation experience modeled after real-life scenarios. Simulation-based learning has been widely used, examined, and studied for over six decades in many professional fields like management, engineering, nursing, and medicine.¹ It was first introduced in aviation by Edwin Link's invention in 1929 of the first flight simulator, which was named the "Blue Box".^{2,3}

In medicine and education, medical simulation—with models and computerized manikins that look like the human body—is commonly used to train and educate healthcare providers and students.⁴ In ancient times, medical simulation models originated with the use of clay and stones. In the 18th century, an obstetrical manikin of a human pelvis and a dead infant allowed obstetricians to teach delivery on simulators, lowering mortality rates.⁵

Simulation-based medical education provides a safe, controlled environment, where problem-based learning can prosper, and interprofessional competencies are examined.⁶ In addition, simulation helps in the practice and sharpening of procedural, diagnostic, and communication skills, and the development of self-confidence.⁷ Simulation-

based learning has been proven to be beneficial in many studies among undergraduate medical students. For example, Agha⁸ investigated the effectiveness of simulation-based learning for medical students and concluded that it is a helpful and successful learning approach. Moreover, it is a useful learning tool from the perspective of not only educators but also students.⁷ In Poland, a survey of undergraduate satisfaction with the use of high-fidelity simulations in a nephrology course found that it improved their clinical reasoning and decision-making skills.⁹ However, in Saudi Arabia, the orientation of healthcare educators in using effective simulation-based learning has not been examined substantially.

Simulation is increasingly being used in medical education to teach individuals and groups cognitive, psychomotor, and affective skills. It is imperative first to determine the outcomes of using medical simulation and examine the challenges and needs seen by the educators, using it as a learning method, to achieve a fruitful integration into the curriculum. There are many simulation centers in Saudi Arabia, but most are not fully exploited for medical simulation. Previous studies have reported that effective use of medical simulation contributes to improving patients' safety.¹⁰ While literature presents several challenges in the use of simulation, one of the main challenges of simulation-based medical education is the educator's lack of experience in simulation teaching strategies.¹¹ Therefore, this study aims to contribute to the integration of medical simulation into health professions education programs through the orientation of healthcare educators. Using Q-sort method to capture subjective views, this study therefore explores the healthcare educators' orientations about medical simulation in clinical skills training —its benefits, needs, challenges, and implications for proper implementation and integration into curricula.

Materials and Methods

General Overview of Q Methodology

Q-methodology (Q-sort) has been used in academic psychology, communication, political science, and behavioral and health sciences.¹² The mixed methods approach of Q-methodology is suitable for analytically exploring and illuminating patterns and diversity in a subjective experience. In Q-methodology, the participants engage in a Q-sorting where they rank a set of items (statements) on a pre-determined grid according to their level of agreement or disagreement (Figure 1). Usually, participants pre-sort the statements into three piles (agree, neutral, and disagree) before ranking them on the grid to break the task down and make it easier. Quantitative data are gathered in the form of Q-sorts (participants' patterns of organizing the statements on the grid) and their subsequent intercorrelation merged in a by-person factor analysis.¹³ In a by-person factor analysis, participants are analyzed as the variables of the study. Then, qualitative data are commonly collected by asking the participants to elaborate on why they placed the items at the two extreme ends of the grid or by conducting a post-sort interview to reinforce the researcher's interpretations. Q-methodology is recognized by Watts and Stenner¹³ as an extremely robust method for holistically exploring subjective opinions on any given topic, as it invites participants to actively shape their perspectives on a set of items, drawing on the "effort after meaning" theory.¹⁴ Using Q-methodology aims to identify shared orientations and then to generalize the findings' concept at the population-level.

Q-Set Design and Content

A Q-study comprises a set of items (Q-set or "concourse") that participants are asked to sort and rank. For this study, we initially collected 54 statements covering all aspects of medical simulation from a literature review and informal interviews (developing the "concourse"). Some of the statements were adopted with permission from Landeen et al¹⁵ but were modified for the purpose of the study. Subsequently, the 54 statements were piloted and reviewed for relevance and validation by two content experts in medical simulation. Having consulted a Q-methodology expert, we revised and reduced the statements to a total of 44 statements (Figure 2). The Q-set (44 items) in this study meets the standard number of items (40–80) proposed by Curt.¹⁶ The research team structured the statements under three themes; benefits, needs, and challenges to have a balanced set of statements. Further, the statements were categorized based on relevance to students, facilitators, resources, and usage to represent all aspects of medical simulation. The participants were not informed about the themes nor the categories to avoid influencing participants' orientations. However, the 44 statements

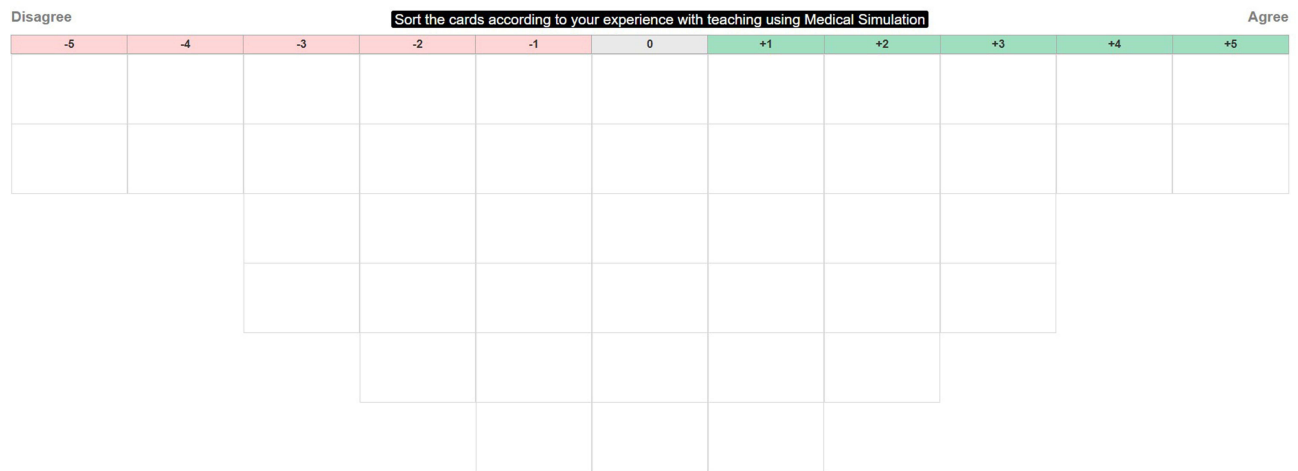


Figure 1 Q-sorting grid of the 44 statements.

were designed to be controversial to engage the participants actively and elicit different reactions, as suggested by Watts and Stenner.¹³

Settings and Participants

The study was conducted at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in Riyadh, Saudi Arabia. The university has a fully equipped Clinical Simulation Center hosting medical simulation sessions to educate health professions students. The participants were health professionals who are involved in simulation-based learning at KSAU-HS. Brown¹⁷ emphasized that the aim of Q-methodology is to reach, understand, and explain the existing orientations and compare them; therefore, it can be applied to very few participants. As each participant acts as a variable, it is recommended to have a limited number of variables. We purposively recruited 22 participants for this study with a ratio of one participant for every two statements, as suggested by Kline.¹⁸ We recruited both male and female participants of various ages and with varying levels of experience with medical simulation. We also recruited from various specialties in medicine and surgery (Radiology, Hematology, Neurology, Transplant, Obstetrics and Gynecology), applied medical sciences (Respiratory Therapy, Emergency Medical Services), and nursing to ensure diversity in views (Table 1). In addition, those who were from the same department were recruited through snowball sampling technique. Healthcare educators who frequently conduct medical simulation sessions were included.

Implementation

After receiving approval from the Institutional Review Board (IRB), each participant was asked to provide informed consent online. The anonymity and confidentiality of the information were ensured. The participants were asked to access a webpage developed using Easy HTMLQ and pre-sort and rank the set of statements along a quasi-normal continuum on a fixed grid from (+5) to (−5) (Figure 1). The rank ordering was instructed as follows: first, participants were asked to read all statements and categorize them in three piles: agree, disagree, and neutral. Next, they were asked to read the statements in the “agree” pile once again and select the two statements with which they strongly agreed and place these in the two spots on the right-hand side of the score sheet (+5). Then, they were asked to read the remaining statements of the pile, select the next most agreeable items, and place them in the next column (+4). This process was repeated until no statements remained in the pile. A similar procedure was followed for the “disagree” pile (then ordering from left to right), and for the “neutral” pile (placed in the remaining open spots in the middle). After completing the ranking of the statements, participants were asked open-ended questions to explain their ranking of the statements at the extreme ends (+5) and (−5). This narrative information supported the interpretation of the quantitative findings and was used for

Statement #	Statements
1	Medical simulation provides an opportunity for the learners to experience the complexity of the clinical settings.
2	I need a fully-equipped simulation center to provide an effective simulation session
3	I can provide an effective simulation with a low budget.
4	Medical simulation prepares the trainees for what they will face as healthcare providers in real life.
5	I find it difficult to obtain the resources necessary to train learners using medical simulation.
6	Using medical simulation as a teaching method should always be a part of the curriculum.
7	Faculty using medical simulation require training to conduct effective sessions.
8	Medical simulation greatly enhances the learners' soft skills (communication, leadership, teamwork).
9	Medical simulation requires a lot of work and effort to conduct.
10	Using medical simulation as an assessment tool is essential for assessing practical and clinical skills without putting patients at risk.
11	The current state of support provided by my college to simulation education is a major hindrance.
12	Only a skilled facilitator can motivate and engage learners with the simulated scenario.
13	Educational leaders support for simulation-based teaching is important for the implementation of effective simulation activities.
14	High-fidelity manikins are needed to conduct an effective simulation session.
15	Even though students say it was very useful to them, we may not necessarily have seen that translate in the clinical setting.
16	Medical simulation sessions are a scheduling nightmare.
17	Producing a believable proper scenario requires a lot of time in the laboratory.
18	To achieve wide use of simulation, we need more resources that help us reach different kind of scenarios.
19	Using simulation reduces the students' stress when transitioning to the clinical setting.
20	Training on medical simulation models and manikins is the best choice for teaching psychomotor skills.
21	Medical simulation can replace bedside training.
22	Simulations help students learn how to collaborate with members of an interprofessional team.
23	The learning curve to use simulation technology for teaching is a huge obstacle on the faculty.
24	Limitations on space given for simulation make it difficult to fully simulate the clinical experience.
25	An effective simulation does not need many resources. A good educator can work with any resources available.
26	Because of simulation, we now make better use of the learning time students have in the clinical setting.
27	Simulation teaching creates a highly realistic, yet safe and reproducible learning environment.
28	We need clinical instructors who have received proper training to achieve an effective simulation teaching.
29	I believe constructing simulation sessions and courses help in the settings of remediation.
30	Simulation fills the gap because students will not always have a chance to perform skills in clinical settings.
31	A big disadvantage of simulators is that students cannot tell if they are hurting them; therefore, reduces students' empathy when dealing with patients.
32	Lack of human resources in our program hinders a full integration of simulation-based learning in the curriculum.
33	We must use medical simulation more often (at least once a month) to achieve its benefits.
34	I have a positive attitude toward using simulation for medical education.
35	Integrating simulation into the curriculum will require more from me than traditional teaching.
36	Learning by using simulation can stand in the way of providing a standardized teaching experience for all students.
37	You cannot conduct effective simulation-based learning without being able to provide an appropriate feedback.
38	Having supporting staff is essential for the growth and wide use of medical simulation.
39	Simulation teaching can completely overcome the problem of uncooperative patients during the practice experience.
40	Simulation teaching minimizes the needed effort put in by educators in the clinical setting.
41	Medical simulation teaching should be minimum because it is very time-consuming.
42	The enormous number of students and limited opportunities to interact with patients calls for increasing the use of simulation teaching.
43	A healthcare educator must be trained to conduct an effective simulation-based learning.
44	Securing funds is the only way to improve the current use of medical simulation.

Figure 2 The list of 44 statements (Q-set) used in this study for the participants to place on the grid.

elucidation of the results. Finally, the participants answered some demographic and background questions on the same webpage as an online-based questionnaire.

Data Analysis

Ken-Q Analysis web application was used to analyze quantitative data (<https://shawnbanasick.github.io/ken-q-analysis/>). The application identified the correlation between the participants (ie, variables). Then, a total of 22 Q-sorts were intercorrelated and analyzed through a Q-factor analysis, a by-person factor analysis. Principal Component Analysis (PCA) was conducted to formulate (factors) representing the shared orientations from the participants' Q-sorts that were highly correlated together. Next, Varimax rotation was applied to maximize the study variance, as recommended for exploratory studies.¹⁹ We identified factors that met the 4 selection criteria: simplicity, clarity, distinctness, and stability.²⁰ Therefore, we identified three such factors (orientations), which explained 56% of the study variance with eigenvalues greater than 1. All 22 Q-sorts were significantly associated with (loaded on) at least one of the three extracted factors; however, we removed 6 Q-sorts because they were loading on more than one factor (confounded Q sorts). Participants' Q-sorts that had a similar pattern were loaded and flagged in the same factor [factor loading of

Table 1 Demographic Information of the Participants (N = 22)

Demographics	Number of Participants	Percentage
Gender		
Male	11	50
Female	11	50
Age		
Less than 30 years	7	31.8
30–34 years	5	22.7
35–39 years	5	22.7
40 years and above	5	22.7
Specialty		
Applied medical sciences	11	50
Medicine	7	31.8
Nursing	4	18.1
Designation		
Head of department	1	4.5
Associate professor	1	4.5
Assistant professor	9	40.9
Lecturer	2	9
Teaching assistant	6	27.2
Instructor	2	9
Coordinator	1	4.5
Experience in medical simulation		
Less than 1 year	1	4.5
1–2 years	8	36.3
3–5	7	31.8
More than 5 years	6	27.2
Previous training in medical simulation		
Received previous training	6	27.2

± 0.4 or above were significant at $p < 0.01$ level] (Table 2). Participants with the flagged Q-sorts in one factor had a similar orientation on the use of medical simulation. By a calculated weight average procedure, the flagged Q-sorts were merged into one best possible Q-sort per factor called factor array, ie, each factor array is the combination of the flagged Q-sorts associated with one factor. The three factor arrays were then interpreted to represent the shared orientation held by the participants loaded on each factor, respectively.

The analysis and interpretation of the factor arrays is a crucial step in Q-studies. Therefore, we followed the guidance of Watts & Stenner¹³ to maintain the holistic nature of Q-methodology.²¹ The interpretation was done by thoroughly and

Table 2 Factor Matrix with Defining Sorts Flagged

Q Sort Number	Factor 1		Factor 2		Factor 3	
1	0.8339	Flagged	0.2105		-0.0675	
2	0.6454	Flagged	-0.0533		0.0841	
3	-0.2045		-0.0766		0.8018	Flagged
4	0.6525	Flagged	-0.0882		0.2266	
5*	0.4108		0.5537		0.3115	
6	0.6305	Flagged	0.0413		0.1357	
7*	0.5823		0.5325		0.2188	
8	0.6928	Flagged	0.1083		0.3148	
9	-0.0827		0.6612	Flagged	-0.169	
10	0.3776		0.0403		0.6172	Flagged
11	-0.1193		0.6176	Flagged	0.1781	
12	0.3819		0.4113	Flagged	0.0095	
13*	0.2745		0.5107		0.4274	
14	0.5346	Flagged	0.3888		-0.1709	
15	0.4864	Flagged	0.2543		0.231	
16	0.3815		0.6174	Flagged	0.3271	
17*	0.0318		0.4963		0.5682	
18	0.3862		0.267		0.7034	Flagged
19*	0.4446		0.5216		0.135	
20	0.7541	Flagged	0.2688		-0.0281	
21*	0.6599		-0.0204		0.612	
22	0.1039		0.8625	Flagged	-0.0282	
Explained Variance	24%		18%		14%	

Notes: Factor loading of ± 0.4 or above were significant at $p < 0.01$ level. (*) indicates confounded Q-sorts. Flagged sorts are indicative of participants with a similar orientation in one factor.

carefully examining patterns within the scores of the statements per factor array. We interpreted each factor based on the statements that were ranked highest and lowest. We included statements with scores significantly higher and lower positively and negatively in a factor array compared with the other factor arrays (distinguishing statements). In addition, we used participants' qualitative comments to support and clarify the interpretation of the factors. We assigned a name that captures the essence of the participants' shared orientation represented by each factor in line with the statements that distinguish factors from one another.

Results

The findings of the factors' interpretations are described separately. The relevant statements are provided with their numbers and ranking scores between parentheses below (and Table 3) with the distinguishing statements significant at $P < 0.05$ marked with (*) and at $P < 0.01$ marked with (**).

Table 3 Scores of the 44 Statements in Each Factor

#	Statements	Factor Arrays		
		1	2	3
1	Medical simulation provides an opportunity for the learners to experience the complexity of clinical settings.	+3	+3	+2
2	I need a fully equipped simulation center to provide an effective simulation session	-4	+2**	-3
3	I can provide an effective simulation with a low budget.	+1**	-4	-4
4	Medical simulation prepares the trainees for what they will face as healthcare providers in real life.	+4	+3	+3
5	I find it difficult to obtain the resources necessary to train learners using medical simulation.	-4**	0	+1
6	Using medical simulation as a teaching method should always be a part of the curriculum.	+5**	+1*	-1*
7	Faculty using medical simulation requires training to conduct effective sessions.	0	+2	+1
8	Medical simulation greatly enhances the learners' soft skills (communication, leadership, teamwork).	+1	+1	+1
9	Medical simulation requires a lot of work and effort to conduct.	-3**	+1	+2
10	Using medical simulation as an assessment tool is essential for assessing practical and clinical skills without putting patients at risk.	+1**	-2	-1
11	The current state of support provided by my college to simulation education is a major hindrance.	-2	-3	-3
12	Only a skilled facilitator can motivate and engage learners with the simulated scenario.	-1	-1	-3
13	Educational leaders' support for simulation-based teaching is important for the implementation of effective simulation activities.	0**	+2	+4
14	High-fidelity manikins are needed to conduct an effective simulation session.	-1**	+4**	-5**
15	Even though students say it was very useful to them, we may not necessarily have seen that translate in the clinical setting.	-2**	-4**	+4**
16	Medical simulation sessions are a scheduling nightmare.	-5**	-3**	+1**
17	Producing a believable proper scenario requires a lot of time in the laboratory.	-2*	-1	0
18	To achieve wide use of simulation, we need more resources that help us reach different kinds of scenarios.	0	-1	+1
19	Using simulation reduces the students' stress when transitioning to the clinical setting.	+2*	+1	0
20	Training on medical simulation models and manikins is the best choice for teaching psychomotor skills.	+2	+3	-2**
21	Medical simulation can replace bedside training.	-3**	-5**	-5
22	Simulations help students learn how to collaborate with members of an interprofessional team.	+2	+2	+5*
23	The learning curve to use simulation technology for teaching is a huge obstacle to the faculty.	-3*	-2	-2
24	Limitations on space given for simulation make it difficult to fully simulate the clinical experience.	-1	+2*	0
25	An effective simulation does not need many resources. A good educator can work with any resources available.	+3**	-3	-4
26	Because of simulation, we now make better use of the learning time students have in the clinical setting.	+2*	0	-1
27	Simulation teaching creates a highly realistic, yet safe and reproducible learning environment.	+3	0	+2
28	We need clinical instructors who have received proper training to achieve effective simulation teaching.	-1	+3**	0
29	I believe constructing simulation sessions and courses help in the settings of remediation.	0**	+4**	-2**
30	Simulation fills the gap because students will not always have a chance to perform skills in clinical settings.	+1	0	+3**

(Continued)

Table 3 (Continued).

#	Statements	Factor Arrays		
		1	2	3
31	A big disadvantage of simulators is that students cannot tell if they are hurting them; therefore, reduces students' empathy when dealing with patients.	-1**	-5**	+3**
32	Lack of human resources in our program hinders a full integration of simulation-based learning in the curriculum.	-2	-2	+1**
33	We must use medical simulation more often (at least once a month) to achieve its benefits.	+5**	-1	-1
34	I have a positive attitude toward using simulation for medical education.	+3	+5	0**
35	Integrating simulation into the curriculum will require more from me than traditional teaching.	-1	0	+2**
36	Learning by using simulation can stand in the way of providing a standardized teaching experience for all students.	-2	-2	-3
37	You cannot conduct effective simulation-based learning without being able to provide appropriate feedback.	+4	-1**	+5
38	Having supporting staff is essential for the growth and wide use of medical simulation.	0	+1	+2
39	Simulation teaching can completely overcome the problem of uncooperative patients during the practice experience.	+1*	-1	-2
40	Simulation teaching minimizes the needed effort put in by educators in the clinical setting.	0	0	-1
41	Medical simulation teaching should be minimum because it is very time-consuming.	-5**	-3	-2
42	The enormous number of students and limited opportunities to interact with patients calls for increasing the use of simulation teaching.	+2	-2**	+3
43	A healthcare educator must be trained to conduct effective simulation-based learning.	+1*	+5**	-1*
44	Securing funds is the only way to improve the current use of medical simulation.	-3**	+1	0

Notes: (*) Distinguishing statement significant at $P < 0.05$. (**) Distinguishing statement significant at $P < 0.01$. A factor array represents the loaded participants' orientations in one factor; combined in the form of a single Q-sort¹³.

Abbreviations: PCA, principal component analysis; IRB, Institutional Review Board; KSAU-HS, King Saud Bin Abdulaziz University for Health Sciences; KAIMRC, King Abdullah International Medical Research Center.

Factor 1 Interpretation (Minimalists)

Factor 1 sheds light on faculty members who consider medical simulation a simple, effortless, and beneficial method of teaching and learning. They reported that medical simulation sessions did not require a lot of effort or time to properly produce a scenario (9: -3**; 17: -2*). In comparison with traditional teaching, they expressed that integrating medical simulation into the curriculum does not require additional effort on their part (35: -1). Therefore, they not only strongly disagreed with minimizing medical simulation due to time constraints (41: -5**) but also opposed referring to scheduling the sessions as a nightmare (16: -5**) as some mentioned:

- "Simulation sessions can deliver information and knowledge to the students faster than traditional,"
- "I don't think it will be a nightmare if you schedule properly and early,"
- "No, when we have properly trained personnel and passionate personnel it is NOT a nightmare."

They did not perceive resource allocation as a challenge because "the college provides everything," as one participant stated (5: -4**). The participants loading on this factor seemed to view medical simulation as an uncomplicated method as one participant suggested,

"It is a simple task to perform, organize and prepare with very simple resources. Any healthcare educator can provide it without sophisticated equipment or manikins."

Factor 1 represented the belief that any good educator could produce an effective session without requiring a lot of resources (25: +3**); as one said, “I could run a well effective session with tiny resource and improvisation”. The participants loading on this factor did not consider securing funds as the only way to improve the current use of medical simulation (44: -3**). They also agreed that running simulation sessions did not necessarily require clinical instructors who had received proper training in its utilization (28: -1), nor did it require a fully equipped center (2: -4). To them, the learning curve for using simulation technology, a low budget, or limited space were not obstacles to providing an effective simulation of the clinical experience (23: -3*; 3: +1**; 24: -1); as one participant stated, “simulation sessions can effectively be achieved with low budget in the out of hospital care practice (EMS)”. Therefore, the participants strongly supported consistent incorporation of medical simulation in the curriculum (6: +5**), and a more frequent application to achieve its benefits (33: +5**).

The orientation represented by Factor 1 showed that participants loading on this factor valued the benefits of medical simulation. As some participants stated, “It’s necessary nowadays, it will keep students oriented more about their objectives. Also, it would be easier for them to apply the skills in real life,” “there are no other ways to training the students for these skills without harming the patient,” “it’s a beneficial method for students to apply what they have learned.” They agreed that medical simulation was an essential assessment tool to measure practical and clinical skills (10: +1**). Further, they perceived it beneficial in overcoming the problem of uncooperative patients and in reducing students’ stress and making better use of students’ time in the clinical setting (39: +1*; 19: +2*; 26: +2*).

Factor 2 Interpretation (Optimistic Worriers)

Factor 2 depicted an optimistic view of medical simulation outcomes, but one that was concerned about the resources, and the facilitator capabilities. Participants loading on factor 2 showed a positive attitude toward using medical simulation because they reported it was helpful for remediation and was the best choice for learning psychomotor skills (34: +5; 29: +4**; 20: +3):

- “Simulation session is a good method for practice and preparation”
- “It can provide an opportunity for the learner to practice the patient’s assessment and create a treatment plan”
- “I believe running simulations will stimulate the approach to quick diagnosis and management”

Overall, Factor 2 participants recognized the positive impact of medical simulation on students in clinical settings (15: -4**) as one compared, “Students who have been trained by simulation are different than those who haven’t in the clinical”. They strongly disagreed with the claim that medical simulation reduces students’ empathy when dealing with patients; however, they described that medical simulation was a supplement to bedside training rather than a replacement for it (31: +5**; 21: -5**). One participant summarized this point,

“we must prepare the students on how to examine and what they should do in the simulation center, then they have to go to the patient. The student must see and be trained on a patient but as a second step.”

Nevertheless, they do not regard medical simulation as a key assessment tool, nor do they believe that using medical simulation more often is necessary to reap its benefits (10: -2; 33: -1).

To conduct an effective simulation session, the participants loading on factor 2 emphasized the need for a fully equipped simulation center, with high-fidelity manikins. As one said, “they help mimic the real situation,” but require enough space to simulate the clinical experience completely, “we need enough space to mimic real-life scenarios and high-fidelity cases.” (2: +2**; 44: +1; 24: +2*). In addition, factor 2 participants reported that providing effective simulation with low budget was a challenge and that funds and the support of educational leaders could improve the current use of medical simulation (3: -4; 44: +1; 13: +2); “without support of stakeholders and having enough budget, clinical simulation will not be efficient or deliver its message,” a participant commented. However, the lack of human resources in their programs was not an obstacle to the integration of simulation-based learning (32: -2) but rather the facilitators’ competence.

They agreed that there was a need for professionally trained clinical instructors and emphasized that educators using medical simulation must be trained on how to conduct a complete simulation session and give constructive feedback (28: +3**; 43: +5**; 37: -1**); “Training is important so they can produce effective scenarios.” and “without qualification, the educator cannot perform a beneficial stimulation session”, some stated.

Factor 3 Interpretations (Reluctant Skeptics)

Factor 3 captured the view of those who seemed to struggle with medical simulation and were unenthusiastic about its benefits. They expressed that scheduling sessions and obtaining the necessary resources, such as human resources and funds, could be barriers to using medical simulation (16: +1**; 5: +1; 32: +1**). They even reported that a tutor’s potential could be debilitated by the lack of resources; as one participant reflected, “although the educators’ skills play a vital role in education, their skills will be limited if there are limited resources” (25: -4). However, they agreed that providing an effective simulation session was achievable without high-fidelity manikins or a fully equipped center (14: -5**; 2: -3), as two participants explained:

- “One can manage and improvise with available resources”
- “The fidelity of the situation is much more important than the fidelity of the manikins”

Furthermore, they believed that medical simulation required more work and effort than traditional teaching when integrating it into the curriculum (9: +2; 35: +2**); thus, most agreed that the support of both staff and educational leaders was essential for its implementation (38: +2; 13: +4).

The participants loading on this factor appreciated some of the benefits of medical simulations but doubted others. They strongly agreed that, with proper feedback, a simulation session could be effective in teaching interprofessional collaboration and allowing the students to practice what they could not in clinical settings. As one elaborated, “appropriate feedback is the key to improve the students’ skills as they will know their mistakes and how to improve them” (37: +5; 22: +5*; 30: +3**). However, they had not necessarily seen the positive impact of medical simulation on students in clinical settings, and they doubted that it made better use of the students’ learning time (15: +4**; 26: -1). Even though they were unanimous in increasing the use of simulation teaching (42: +3), they did not describe medical simulation as a solution for the problem of uncooperative patients or effective for remediation (39: -2; 29: -2**). They even expressed that simulators could reduce students’ empathy when dealing with patients (31: +3**). Consequently, participants loading on Factor 3 had a neutral attitude towards medical simulation and did not perceive it as the best method for teaching psychomotor skills or as a replacement for bedside training (20: -2**; 21: -5). This attitude was encapsulated in the following comment:

“Even though the simulation provides a realistic environment, it is still not a real-life experience with a real patient. Stress and other emotions that novices will feel in their training when they face a real patient do not exist (to some degree) in the simulation environment. These feelings have the potential to influence their performance; therefore, integrating bedside training with simulation would be a much better training option.”

Discussion

If appropriately employed, simulation-based learning has several advantages that may enhance the healthcare professionals’ competencies, improve patient safety, and reduce healthcare costs. We identified three factors representing orientations of medical simulation among healthcare educators in Saudi Arabia: one that highlights the simplicity of the method “Minimalists,” a second that emphasizes the positive outcomes of medical simulation despite some concerns “Optimistic Worriers,” and a third that is more inclined to the potential benefits and challenges of medical simulation “Reluctant Skeptics.”

The first factor represented an enthusiastic orientation of medical simulation, which concurs with the labeled factor “Positive Enthusiasts” reported in Landeen et al.¹⁵ Participants were positive about the learning opportunities medical simulation provides, which corresponds with previous studies.^{22,23} Other studies on the effectiveness of medical

simulation have reported that the use of medical simulation increased patient safety, enhanced students and healthcare instructors' skills, and improved healthcare providers' performance by reducing medical errors.^{5,24-28}

In the second factor, learning from experienced faculty was of major importance. Medical educators with an "optimistic" orientation to simulation expressed a primary need for support from both staff and leadership to effectively implement simulation-based learning. In addition, training on high-fidelity simulators and incorporating real patients' interaction with medical simulation were emphasized much more than other aspects. Participants in this factor recognized the importance of scenarios and experienced facilitators to achieve effective simulation-based learning. To address the need for highly qualified and trained instructors, educational institutions should provide opportunities for training in the use of medical simulation conducted by well-trained instructors who also assist in the development of case scenarios.²⁹

We notice that the orientation of the participants representing factor 2 combined seeking help with acquiring resources and training. Moreover, participants loading on factor 3 were critical of medical simulation similar to the two factors labeled "Help Seekers" and "Traditionalists" in Akhtar-Danesh et al.²²

Participants loading on factor 3 were more traditional and preferred using bedside training. The educators in this factor stressed the importance of support and resources, which may have lowered their motivation to use medical simulation; satisfaction of the educators' needs correlates positively with their intrinsic motivation.³⁰ Additionally, educators loading on factor 3 believed that medical simulation was unsuitable for teaching empathy; however, medical simulation can be helpful for learning empathy and developing empathetic behaviors, especially when learners act as patients in the simulation.³¹

Limitations and Implications

The study has certain limitations. Although our data collection technique was to identify distinct orientations, the selection process of participants might have overlooked important simulation-based learning orientations among healthcare educators from different programs. Furthermore, the study was conducted in a short period at a single Saudi university. Nevertheless, the results of the study have some implications. Our findings can be used to address the issues raised by participants and to plan strategically for integrating medical simulation and bedside training into the curriculum to achieve the benefits discussed in the participants' orientations. Unlike the previously mentioned Q-studies on the same subject,^{15,22,23} our study revealed three different factors instead of one or two, which might be due to the various roles and backgrounds of our participants. Even though the data collection method was extensive, we managed to capture the orientations of those with different roles in the academic setting. The statements sorting exercise might be an effective method to help educators self-reflect because participants had to think about the different aspects of medical simulation and its effectiveness. Last, participants appreciated the uniqueness of the data collection in their additional comments.

Conclusion

We identified three orientations towards medical simulation among healthcare educators in Saudi Arabia that are important in the context of the benefits, needs, and challenges of simulation-based learning. We highlighted the importance of faculty training, curriculum integration, and staff and leadership support to successfully make medical simulation effective. Participants were more positive about using simulation to support clinical learning and embraced the accompanying challenges. In addition, faculty awareness of the importance of learning simulation, training in using the method, and providing constructive feedback was noticeable in the participants' orientations. Furthermore, lack of resources, institutional support, and faculty training were identified as challenges to effective integration of medical simulation. For future work, we propose expanding the study across multiple institutions with varying levels of expertise in simulation-based learning, which may provide additional insights that can be employed to compare the data. We also recommend using alternative methodologies, such as combining Q-methodology with surveys and other qualitative studies, to capture the general perceptions of a larger proportion of faculty, students, and higher management. In addition, health profession institutions should consider the role of faculty, availability of resources, and opportunities for continuous training programs to enhance the effectiveness of medical simulation.

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Disclosure

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References

- Hallinger P, Wang R. The evolution of simulation-based learning across the disciplines, 1965–2018: a science map of the literature. *Simul Gaming*. 2019;51(1):9–32. doi:10.1177/1046878119888246
- Aebersold M. The history of simulation and its impact on the future. *AACN Adv Crit Care*. 2016;27(1):56–61. doi:10.4037/aacnacc2016436
- The National Aviation Hall of Fame. Edwin Link; 2020. Available from: <https://www.nationalaviation.org/enshrinees/link-edwin/>. Accessed May 02, 2022.
- Kunkel ME. *Medical Simulations*. Salem Press Encyclopedia of Science; 2019.
- Jones F, Passos-Neto C, Braghiroli OM. Simulation in medical education: brief history and methodology. *Princ Pract Clin Res J*. 2015;1(2):56–63. doi:10.21801/ppcrj.2015.12.8
- Paige JT, Garbee DD, Brown KM, Rojas JD. Using simulation in interprofessional education. *Surg Clin*. 2015;95(4):751–766. doi:10.1016/j.suc.2015.04.004
- Nuzhat A, Salem RO, Shehri FNA, Hamdan NA. Role and challenges of simulation in undergraduate curriculum. *Med Teach*. 2014;36(sup1):S69–73. doi:10.3109/0142159x.2014.886017
- Agha S. Effect of simulation based education for learning in medical students: a mixed study. *J Pak Med Assoc*. 2019;69(4):545–554.
- Pawłowicz E, Kulesza M, Szymańska A, Masajtis-Zagajewska A, Bartczak M, Nowicki M. ‘I hear and I forget. I see and I remember. I do and I understand.’— incorporating high-fidelity medical simulation into the undergraduate nephrology course. *Ren Fail*. 2020;42(1):1184–1191. doi:10.1080/0886022x.2020.1847722
- Sollid SJM, Dieckman P, Aase K, Søreide E, Ringsted C, Østergaard D. Five topics health care simulation can address to improve patient safety: results from a consensus process. *J Patient Saf*. 2019;15(2):111–120. doi:10.1097/pts.0000000000000254
- Ahmed S, Al-Mously N, Al-Senani F, Zafar M, Ahmed M. Medical teachers’ perception towards simulation-based medical education: a multicenter study in Saudi Arabia. *Med Teach*. 2016;38(sup1):S37–44. doi:10.3109/0142159x.2016.1142513
- Brown SR. The history and principles of Q methodology in Psychology and the Social Sciences. Department of Political Science, Kent State University, Kent, OH; 1997. Available from: <http://facstaff.uww.edu/cottlec/Qarchive/Bps.htm>. Accessed May 02, 2022.
- Watts S, Stenner P. *Doing Q Methodological Research: Theory, Method and Interpretation*. Sage Publications Limited; 2012.
- Rogers RS. Q methodology. In: Smith JA, Harré R, Langenhove LV, editors. *Rethinking Methods in Psychology*. 1st ed. London and Thousand Oaks, CA: Sage Publications Limited; 1995:178–192.
- Landeen J, Pierazzo J, Akhtar-Danesh N, Baxter P, van Eijk S, Evers C. Exploring student and faculty perceptions of clinical simulation: a Q-sort study. *J Nurs Educ*. 2015;54(9):485–491. doi:10.3928/01484834-20150814-02
- Curt BC. *Textuality and Tectonics: Troubling Social and Psychological Science*. Open University Press; 1994.
- Brown SR. *Political Subjectivity: Applications of Q Methodology in Political Science*. New Haven, CT: Yale University Press; 1980.
- Kline P. *An Easy Guide to Factor Analysis*. New York: Routledge; 1994.
- Akhtar-Danesh N. A comparison between major factor extraction and factor rotation techniques in Q-methodology. *Open J Appl Sci*. 2017;07(04):147–156. doi:10.4236/ojapps.2017.74013
- Damio SM. The analytic process of Q methodology. *Asian J Uni Educ*. 2018;1:59–75.
- Stephenson W. The inverted factor technique. *British J Psychol*. 1936a;26(4):344–361.
- Akhtar-Danesh N, Baxter P, Valaitis RK, Stanyon W, Sproul S. Nurse faculty perceptions of simulation use in nursing education. *West J Nurs Res*. 2009;31:312–329. doi:10.1177/0193945908328264
- Baxter P, Akhtar-Danesh N, Landeen J, Norman G. Teaching critical management skills to senior nursing students: videotaped or interactive hands-on instruction. *Nurs Educ Perspect*. 2012;33:106–110. doi:10.5480/1536-5026-33.2.106
- AlHarbi WM. Simulation-based medical education: theory and practice. *Int J Sci Eng Res*. 2016;7(5):249–253.
- Chacko T. Simulation-based medical education: using best practices and curriculum mapping to maximize educational benefits in the context of shift toward competency-based medical education. *Arch Med Health Sci*. 2017;5(1):9–15.
- Phrampus PE. Simulation and integration into Patient Safety Systems. *Simul Healthc*. 2018;13(4):225–226. doi:10.1097/sih.0000000000000332
- Sørensen JL, Østergaard D, LeBlanc V, et al. Design of simulation-based medical education and advantages and disadvantages of in situ simulation versus off-site simulation. *BMC Med Educ*. 2017;17(1):20. doi:10.1186/s12909-016-0838-3
- Al Kuwari KM. Simulation - based medical education. *Bahrain Medical Bull*. 2018;40(1):9–10. doi:10.12816/0047451
- Yeun EJ, Bang HY, Ryoo EN, Ha EH. Attitudes toward simulation-based learning in nursing students: an application of Q methodology. *Nurse Educ Today*. 2014;34(7):1062–1068. doi:10.1016/j.nedt.2014.02.008
- Utomo HB. Teacher motivation behavior: the importance of personal expectations, need satisfaction, and work climate. *Int J Pedagog Teach Educ*. 2018;2(2):333. doi:10.20961/ijpte.v2i2.24036
- Bearman M, Palermo C, Allen LM, Williams B. Learning empathy through simulation. *Simul Healthc*. 2015;10(5):308–319. doi:10.1097/sih.0000000000000113

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