

Medical simulation as perceived by students: where are we, and where are we heading?

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Abstract

Introduction: Educational methods involving medical simulation are widespread and standard tools, appreciated by both medical students and educators.

Aim of the research: To investigate the opinions of students of selected medical study programs concerning medical simulation (MS)-based classes.

Material and methods: A survey questionnaire was conducted on 254 students of medicine, nursing, and paramedicine. The questionnaire consisted of 10 closed questions and one open-ended question, in which respondents could suggest changes to improve the quality of MS-based classes.

Results: Most respondents (87%) felt that MS-based classes facilitated learning and the acquisition of practical skills. For nearly 83% of respondents, the number of MS-based classes was insufficient. According to 85% of students, MS-based classes increased their involvement in classes. Most students (92%) appreciated ‘debriefing’ as a component of the simulation but believed that this element of MS needed to be improved to achieve particular learning outcomes. Next, the results were analysed by comparing them in groups according to the medical study programme. The main differences concerned interdisciplinarity, number of hours of MS-based classes, and the role of simulation in medical education. Answers given to the open-ended question highlighted the need to extend theoretical knowledge as part of preparation for MS-based classes, to thoroughly explain technical aspects of available equipment, to increase teachers’ preparation given the specificity of the classes, and to master ‘debriefing’ techniques.

Conclusions: Students value MS-based classes. However, their quality should be improved to optimally capitalise on the benefits of this method and to achieve expected learning outcomes.

Introduction

Medical simulation (MS) is a method of experiential learning in the controlled setting of the Medical Simulation Centre (MSC). It develops learners’ practical skills and social competences in conditions that mimic real ones via simulated clinical cases based on prepared scenarios. This is done under safe and reproducible conditions in accordance with current standards of knowledge [1]. Scenarios can be conducted individually or, mostly, by a team of the same or different specialties [2].

In 1956 at a conference in Norway, attended by Asmund Laerdal, a plastic toy manufacturer who launched the first Resusci Anne CPR manikin, insights from studies by Peter Safar and James Elam on the effectiveness of mouth-to-mouth rescue breathing were presented [3]. Subsequently, a manikin for performing external cardiac massage was designed, and then a ‘pa-

tient’ for diagnosing cardiac diseases [4]. In Poland, MS was introduced to medical education in 2010–2012. The first patient simulator was bought in 2009 for the Department of Anaesthesiology of the Medical University of Warsaw, and the first interdisciplinary MSC was created in 2010 in Poznan [1].

The following types of MS are currently used:

- 1) High-fidelity simulation (HFS) – the patient is substituted with a simulator or a simulating patient. Audio-visual equipment and appropriate software enable the scenario to be replayed to analyse mistakes and draw constructive conclusions [5].
- 2) Intermediate-fidelity simulation (IFS) – uses simulators that reproduce basic vital functions: heart rate or breathing sounds, but without such functions as speaking, chest movements, or eye opening [6].
- 3) Low-fidelity simulation (LFS) – the equipment supports the acquisition of manual dexterity and spe-

- cific skills, e.g. inserting a peripheral venous access. LFS rooms are exemplified by those intended to train resuscitation or communicative competences [5].
- 4) Trainers – clinical skill trainers are simple devices that enable the assessment of physiological or pathological conditions (ear examination trainers, IV trainers, or breast examination trainers). Advanced trainers allow an immediate assessment of the performed activities, e.g. intramuscular injection trainer that indicates incorrect injection site [7].
 - 5) Human patient simulator (HPS) – advanced phantoms that enable the realistic presentation of physiological conditions, e.g. human vital parameters, as well as diseases and pathological conditions. HPS procedures include intubation, alternative methods of airway clearance, defibrillation, venous access, and other invasive procedures, most of which students would be unable to practice during traditional teaching [7].
 - 6) Computer simulation (CS) – computer software enables the learning of e.g. resuscitation procedures. The software combines video and computer graphics to run scenarios that allow instructors to assess students' critical thinking [7].
 - 7) Standardised patients (SP) – a patient may be impersonated by an amateur or actor (also medical staff) prepared for the presentation of particular symptoms. SPs may be equipped with additional devices, e.g. the SimShirt system, designed for auscultation training, a vest enabling pleural drainage or simple intra-abdominal procedures. Soft skills, crucial for cooperation between medical staff and patients, are also practiced [5, 8].

The simulation session should be conducted professionally, with proper attention paid to each of its stages:

- 1) Prebriefing is an informative or orientation session. Students are given instructions or preparatory information. Educators plan roles and prepare the room, equipment, simulator, and time allocation for the task [9].
- 2) Simulation session consists of patient care (actor, simulator, peer), preceded by a medical interview. Students play their allocated roles (treatment or nursing) [10].
- 3) Debriefing involves discussing the completed scenario in a comfortable and safe setting. Participants learn which elements they have performed correctly and which require improvement [10, 11].

Aim of the research

To investigate the opinions of students of three medical study programs on MS-based (MSB) classes.

Material and methods

The participants comprised 254 students of medicine, nursing, and paramedicine. A survey questionnaire (10 closed questions and 1 open-ended question) about MSB classes was conducted.

The 5-point Likert scale was used, whereby the points were denoted as follows: (1) strongly disagree; (2) moderately disagree; (3) neither agree nor disagree (neutral); (4) moderately agree; (5) strongly agree [12].

The questionnaire was distributed via Google Forms and social media (August 2023–February 2024). Participation was voluntary and anonymous.

The results were analysed with MS Excel 2019 software, considering participants' medical study program, age, and gender.

Results

The study group

The study group consisted of 254 participants (70.1% females, 29.5% males). Most respondents (74.8%) were in the age group of 18–24 years, 17.7% in the group 25–30 years, and 7.5% were older than 30 years. Participants were divided into three groups, depending on their medical study program: medicine (90; 35.4%), nursing (60; 23.6%), or paramedicine (104; 40.9%). Detailed analyses were conducted within these groups. Participation in HFS classes was declared by 62.6% of students, IFS by 51.6%, and LFS by 59.1%. Only 7.5% did not have classes utilising any form of MS (Table 1).

Analysis of the survey questionnaire

The majority (87%) of students believed that MSB classes facilitated learning, and 71% strongly agreed with this; 60% of respondents were strongly in favour of the benefits of MSB classes, and 17% felt that such classes were rather advantageous. Only 5% of students indicated that such classes definitely did not facilitate learning. Our attention was drawn by a very positive assessment of such learning presented by paramedicine students (96% of whom claimed that MSB classes facilitated the learning process).

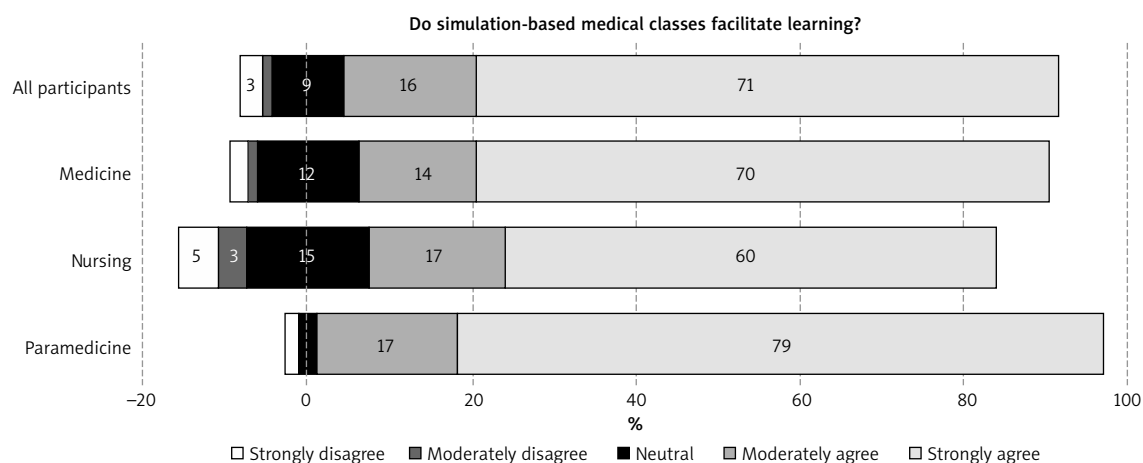
To compare, 70% of students of medicine strongly supported this form of learning, 14% believed that it was rather advantageous, and only 3% claimed that MSB classes did not facilitate learning (2% strongly disagree, 1% disagree). The largest percentage of subjects who claimed that MSB classes did not facilitate learning studied nursing (Figure 1).

A large majority of respondents believed that MSB classes facilitated the acquisition of practical skills: 69% strongly and 18% moderately agreed (Figure 2). Paramedicine students voiced the most positive assessment: 76% strongly and 18% moderately agreed. Students of medicine were slightly less positive: 74% strongly and 16% moderately agreed. The most negative attitude was presented by students of nursing: 7% strongly and 10% moderately believed that various types of simulation did not aid the development of practical skills.

In total, 83% of respondents believed that the number of MSB classes was insufficient. This opinion was

Table 1. General characteristic of the study group

Parameter	Study programme			All participants
	Medicine	Nursing	Paramedicine	
	<i>n</i> (Group %)	<i>n</i> (Group %)	<i>n</i> (Group %)	<i>n</i> (Overall %)
Gender				
Female	63 (70%)	52 (87%)	63 (61%)	178 (70%)
Male	27 (30%)	8 (13%)	40 (38%)	75 (30%)
No answer	0	0	1 (1%)	1 (< 1%)
Age				
18–24	71 (79%)	39 (65%)	80 (77%)	190 (75%)
25–30	19 (21%)	9 (15%)	17 (16%)	45 (18%)
30–34	0	6 (10%)	4 (4%)	10 (4%)
35-40	0	5 (8%)	2 (2%)	7 (3%)
Above 40	0	1 (2%)	1 (1%)	2 (1%)
Participation in simulation				
High fidelity (HFS)	58 (64%)	42 (70%)	59 (57%)	159 (63%)
Intermediate fidelity (IFS)	51 (57%)	25 (42%)	55 (53%)	131 (52%)
Low fidelity (LFS)	66 (73%)	30 (50%)	54 (52%)	150 (59%)
No simulation	3 (3%)	8 (13%)	8 (8%)	19 (7%)
Number (overall %)	90 (35% of all)	60 (24% of all)	104 (41% of all)	254 (100%)

**Figure 1.** Respondents' opinions regarding the facilitation of learning during MS-based classes, including the medical study programme

given by 81% of medicine students, 73% of nursing students, and 89% of paramedicine students (Figure 3). As many as 7% of nursing students believed that the number of MSB classes was too large. This tendency was more pronounced among males (13%) than females (6%). Only 16% of all participants believed that the number of MSB classes offered was sufficient: 11% of paramedicine students, 19% of medicine students, and 20% of nursing students.

Irrespective of the medical study programme or gender, MSB classes increased student involvement and participation in class: 61% strongly agreed and 24% moderately agreed (Figure 4). Paramedicine students unequivocally indicated a positive effect of such classes on their education process (68% strongly, 23% moderately). No paramedicine students strongly disagreed with this statement, and only 2% moderately disagreed.

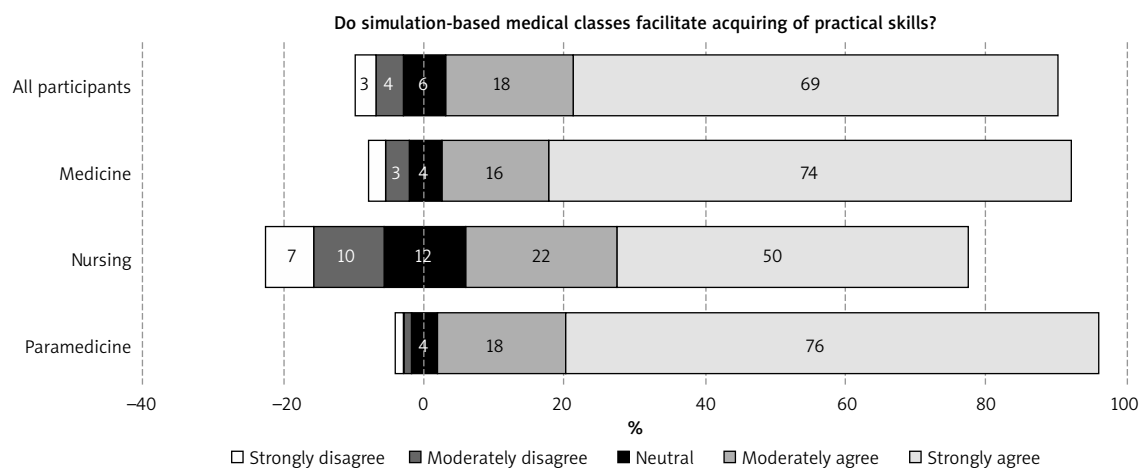


Figure 2. Respondents' opinions regarding the facilitation of acquiring practical skills during MS-based classes, including the medical study programme

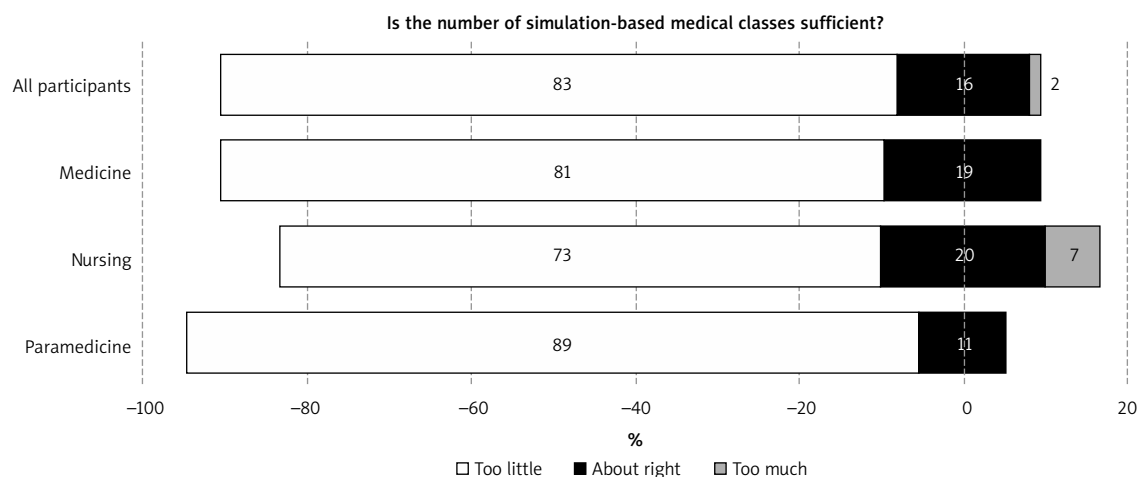


Figure 3. Respondents' opinions regarding the number of MS-based classes, including the medical study programme

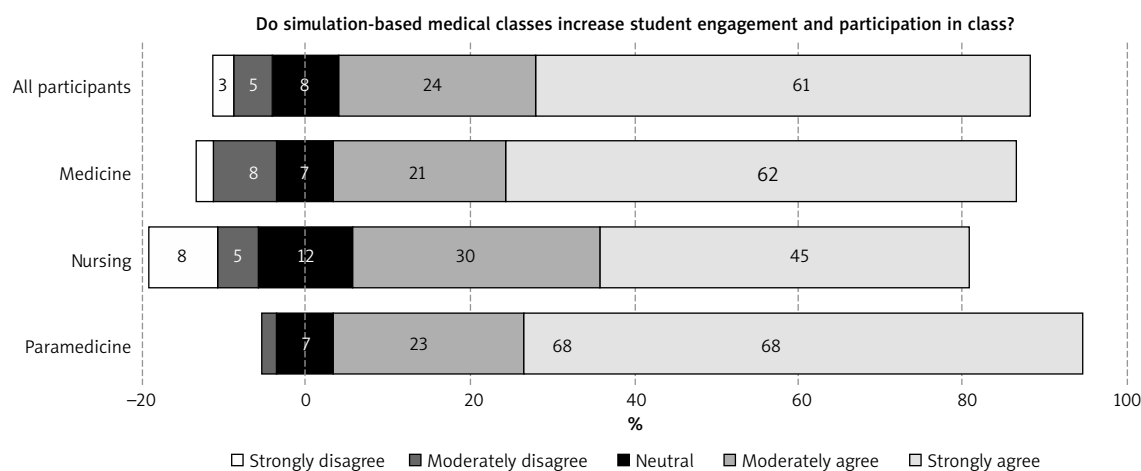


Figure 4. Respondents' opinions regarding the impact of MS-based classes on increasing student involvement and participation in class, including the medical study programme

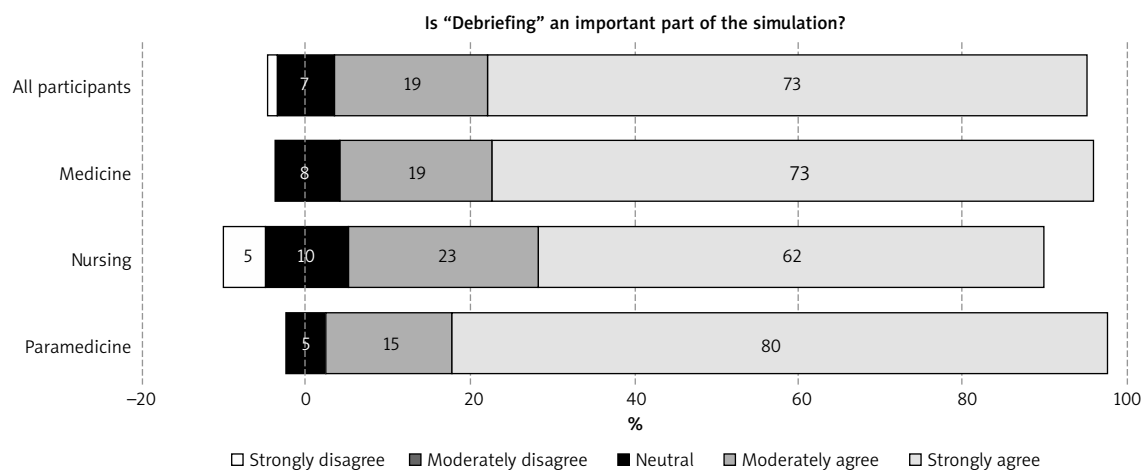


Figure 5. Respondents' opinions regarding debriefing as part of the simulation, including the medical study programme

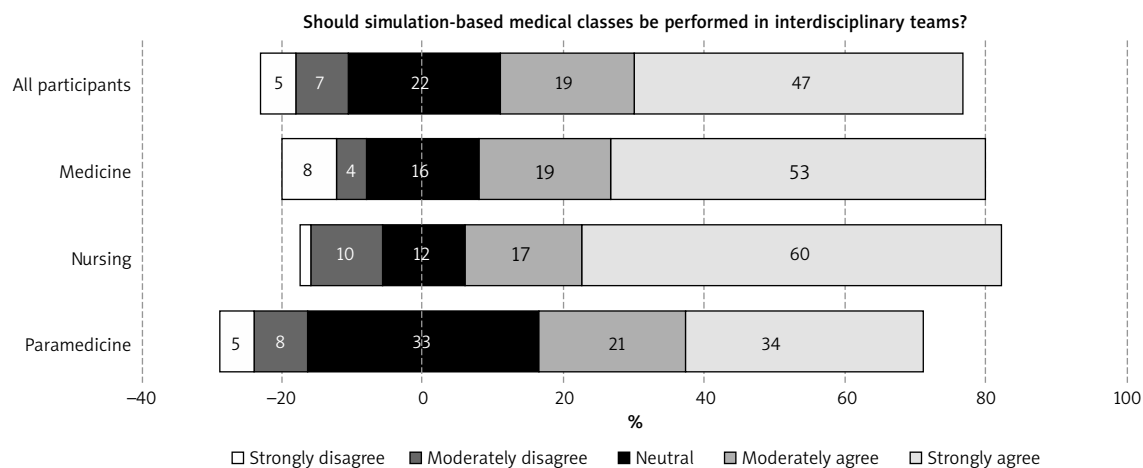


Figure 6. Respondents' opinions regarding conducting MS-based classes in interdisciplinary teams, including the medical study programme

To compare, 8% of medicine students believed that MS did not increase, and 2% claimed that MSB classes definitely did not increase involvement and participation in class. A rather positive impact was noticed by 21%, and definitely positive by 62% of medicine students.

Debriefing was seen as a very important part of MS by nearly all participants, irrespective of the medical study programme or gender: 92% claimed that it was a significant element of the MSB class (73% strongly agreed, 19% moderately agreed). Eighty percent of paramedicine students strongly agreed and 15% moderately agreed with this opinion (Figure 5). These values were, respectively, 73% and 19% among medicine students, and 62% and 23% among nursing students. Only 5% of nursing students believed that debriefing is rather unimportant. In this group, negative opinions were more frequent among males (13%) than females (4%).

Only 66% of respondents agreed that MSB classes should be conducted in interdisciplinary teams: for 19% this would be rather advantageous and for 47% this would be definitely positive (Figure 6). Paramedicine students remained most neutral (33% gave a neutral answer, 21% moderately agreed, and 34% strongly agreed). Among medicine students, 16% provided a neutral answer, 19% moderately agreed, and 53% strongly agreed. Only 8% of medicine students claimed that MSB classes definitely should not be conducted in interdisciplinary teams, and 4% moderately disagreed. The strongest disapproval was voiced by paramedicine students (8% were moderately against and 5% strongly against). Although 10% of nursing students moderately disagreed that interdisciplinary classes should rather not be conducted, only 1% of these students strongly disagreed with this idea. However, 77% of nursing students approved of MSB

classes being conducted in interdisciplinary teams (17% had a rather positive attitude and 60% a definitely positive attitude).

Discussion

The study revealed that most respondents (87%) had a positive attitude to MS and felt that MSB classes facilitated the acquisition of knowledge. Also, most respondents indicated that MSB classes facilitated the acquisition of practical skills, and 83% claimed that the number of MSB classes was insufficient. Slight differences among the analysed groups drew our attention.

Respondents aged 18–24 years were more positive about MSB classes. This seems obvious, given the openness of the young generation to new educational methods [13]. These students had a more negative attitude towards interdisciplinary cooperation with students of other medical study programs. This may be related to the COVID-19 pandemic and imposed isolation.

Female students more often emphasised the importance of debriefing and interdisciplinary collaboration. Medical students valued SMB as part of holistic training, helping them prepare for patient contact and to reduce stress [14]. Still, for 8% of respondents, MSB classes did not increase involvement and participation in class. The reason may be complex. Students often pointed to instructors' insufficient content-related and technical preparation and the impossibility to fully use the equipment because of regulatory constraints and fear of damage. Participants of MSB education highlighted a crucial role of educators in conducting classes properly, including preparation [15]. They wished to be informed as to the extent of knowledge required to be prepared for the class. Torres and Kański also stressed that thorough preparation for HFS should include specific theoretical knowledge, verified before the beginning of simulation [16, 17]. Nursing students were slightly more reserved.

While 73% saw the benefits of SMB, a small group (especially males) felt there were too many classes. Some respondents reported a lack of detailed individual feedback.

Nevertheless, nursing students were the most supportive of interdisciplinary sessions, reflecting their profession's openness to collaboration [18, 19].

Paramedics students showed the most unanimous and positive opinions on SMB, probably due to their frequent use of simulation. However, they were more neutral regarding interdisciplinary sessions – perhaps because emergency procedures are highly standardised.

This indicates the need to adapt interdisciplinary sessions to suit the specifics of different fields [20].

Across all groups, concerns were raised about the quality and delivery of debriefing. While most stu-

dents viewed it as important, many felt it was superficial or too focused on errors. Feedback is crucial for effective learning during MSB classes and should be planned and targeted, irrespective of when (during or after the session), how (technique), and by whom (instructor, peers) it is provided. Instructors' training in providing feedback and summarising techniques is the key to the success of this method [15, 21, 22]. Reports that the instructor did not feel like discussing the practiced scenario or focused on mistakes during the debriefing seem worrying. Some students felt a negative pressure related to instructors' comments about an unsuccessful implementation of the scenario, and some felt ashamed because the simulation ended in failure.

Effective debriefing should include constructive feedback and analysis of both mistakes and correct decisions [21, 22].

The quality of simulation equipment also influences student engagement. Scenarios should reflect real-life conditions as closely as possible, using imaging and lab results, and following clinical protocols [16, 17, 23]. A significant challenge for MS instructors is the appropriate planning and arrangement of the MSB session [16]. Students indicated the need to adapt learning outcomes that they should achieve during simulation. Attention was paid to the lack of difficulty gradation of these outcomes. Clinical cases were sometimes too complicated for some students and would rarely occur in real clinical practice. Students lacked prior preparation in the LFS conditions that would aid to more effective performance in further stages of MS. Experts agree that it is important to use a variety of forms of graded difficulty to achieve all the expected learning outcomes [16, 17, 23, 24].

In summary, SMB is widely appreciated, but its effectiveness depends on instructor preparation, scenario quality, and instructional strategy. Interdisciplinary cooperation, while sometimes controversial, is essential for future healthcare practice [25]. Simulation-based education should continue evolving to meet educational and clinical needs.

Conclusions

Proper theoretical preparation of students and technical preparation prior to MSB classes are necessities. Debriefing is an important aspect of MSB education, which requires development and improvement. MSB classes conducted within the framework of medical study programs facilitate the acquisition of both knowledge and practical skills, as well as increase student involvement and participation in class. Students of medicine, nursing, and paramedicine claim that the number of hours allocated to MSB classes is insufficient and should be combined with the quality of teaching. MSB classes conducted in interdisciplinary teams remain a challenge for the future education of students of all medical study programs.

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Ethical approval

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Conflict of interest

The authors declare no conflict of interest.

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