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ORIGINAL ARTICLE

Reflections of Simulation-based Education on the National Core Curriculum of Turkey: A Content Analysis

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Abstract

Background: Simulation-based education prepares medical students to interact with real patients by resembling real environments. There are a variety of methods in simulation-based education from low-fidelity to high-fidelity, and from basic task trainers to complicated mixed methods. Although it is not specified whether a topic in the national core curriculum is related to simulation-based education or not, the national core curriculum draws a general approach for selecting appropriate learning activities in undergraduate medical education. This study aims to reveal adequate simulation methods for the topics in the national core curriculum and to present a tool for simulation method selection criteria.

Method: A content analysis was conducted in a qualitative design. The literature review was conducted to deeply understand the principles of simulation-based education and was used as a guide to evaluate the topics in the national core curriculum. The content analysis of the National Core Curriculum-2020 was conducted to structure a tool for the simulation method selection criteria in undergraduate medical education.

Results: Several simulation methods can be used according to the utilization of medical schools. A total of 20 number main skills were identified as suitable for simulation-based education and methods were matched with these skills with at least three alternatives.

Conclusion: The tool we conducted covers basic to complicated simulation methods that every medical school can adopt according to its facilities. We recommend our tool as a guide in selecting adequate resources while developing simulation-based education in undergraduate medical education.

Keywords: simulation-based education, medical education, medical school

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INTRODUCTION

Simulation-based education prepares medical students to interact with real patients by resembling real environments (1). Simulation-based education has the highest impact when it is structured as a part of the main curriculum. So, it is recommended not to plan simulation-based training as an individual activity but to plan it as an integrated activity (1). To succeed in structuring an integrated curriculum, the principles of the simulation, as well as the materials and methods related to it, should be well understood by curriculum developers.

There are a variety of methods in simulation-based education from low-fidelity to high-fidelity, and from basic task trainers to wearable mixed methods. There are extended reality which are augmented reality (AR) and metaverse/virtual reality (VR) and traditional simulationmethods which are high/low-fidelity simulators (2).

Traditional simulation is defined as simulating a patient-doctor encounter with the help of mannequins and simulated participants (SPs) in the real-like world. There are low-fidelity task trainers, medium and high-fidelity mannequins, and high-fidelity simulated participants (3). Moulage, which is defined as a make-up to make the scenario more realistic, contributes to improving the reality of the simulation. Moulage can be a small scar to a deep wound according to the scenario. It can be applied to either an SP or a mannequin (4). In addition to moulage, facilitators which are defined as the individuals who are the components of the simulation with determined tasks, contribute to creating a real-like environment (5).

High-fidelity mannequins are well-known for their contribution to learning by providing experience and improving self-confidence (6, 7). They can be used for clinical decision-making training and clinical skills training (8, 9). High-fidelity simulators are successful in simulating doctor-patient encounter with their vital responses and changeable findings according to the scenario (10). One of the main limitations of high-fidelity mannequins is they are quite expensive and after repeated applications, they eventually need part replacement (11).

Simulated participant methodology is recommended when the simulation targets competencies related to patient interaction. So, the simulated participant methodology is mostly used for communication skills training. In addition, the SP methodology is one of the most enriching methods with real human existence and its modifiability (12). Because they are real humans, SP methodology may require the highest attention from educators. The engagement of the SPs' should be supported to improve the quality of the simulation (13).

Low-fidelity is mostly used in technical skills training. Recent literature showed that using low-fidelity simulation is sufficient enough to gain technical skills rather than theoretical training + low-fidelity simulation (14). Also, low-fidelity simulators found that they improve the quality of classic training by improving active learning (15). A study showed that simulation conducted with low-fidelity simulators would cause a lower level of stress compared to high-fidelity simulators (16). Yet, in a meta-analysis, high-fidelity simulations were found more effective in learning compared to low-fidelity simulations (17). Still, low-fidelity simulators are accepted as they're sufficient for technical skills training (18, 19). Medium-fidelity mannequins provide reality feeling less than high-fidelity mannequins and more than low-fidelity mannequins. They are low cost mannequins compared to high-fidelity ones (3). Disadvantages of the traditional simulation can be stated as they require more staff, a specific area, and a specific time to apply (11).

Task trainers, which are low-fidelity simulators, are recommended for technical skills training because of their repeatability and cost-effectiveness (3, 20). New technologies provide opportunities for using task trainers more effectively and especially 3D prints play a major role in building replacement parts (21, 22). Not only they are cost-effective but also, they are more accessible too. So, task trainers can be seen as the first step of simulation-based education.

Virtual reality is described as the creation of a whole environment that is needed for simulation training and studying in this created world (metaverse) by tools like headsets or gloves. Different from VR, AR adds some digital data into the real environment (23). One of the main advantages of VR is that almost anything can be added to it. For example, VR can simulate like you're in an emergency room or a disaster area (24). It can allow you to operate a patient (25) in addition to communication, and even you can use a microscope in a VR setting (26). Another advantage of VR is that it is more cost-effective compared to traditional simulators because of its accessibility and feasibility (11). Although VR has some limitations, especially in performing technical skills, it can still be adopted by surgical trainees as a preparatory tool (25).

Hybrid method is defined as using together two different traditional simulation methods in the same session (27). Wearable simulators are highly improved versions of the hybrid method and they're more cost-effective than high-fidelity simulators (28, 29). Wearable simulators provide the closest real patient interaction by their use with simulated participants (28). Mixed method is defined as using together at least two different simulation methods and one of them should be VR or AR (23).

Recent literature mainly focuses on the impact of VR training in medical education (25, 30-32). In a comparison of VR to traditional simulation with high-fidelity mannequins, students stated that VR is a good opportunity to prepare for high-fidelity simulation in technical skills, however, the sickness and dizziness caused by VR limits the use of VR (32). Although they stated sickness because of VR, the participants expressed VR as more enjoyable and fun compared with high-fidelity simulation (31, 32). Among the mixed methods, the integration of VR with 3D hand animation was the most notable method that resembles real environments (33). Another VR+ 3D model was used for percutaneous renal access and it prevents participants from real radiation that traditional simulation (34). Considering most of the study targeted triage, VR or AR presented as alternative methods to traditional simulation in disaster management (24). The common agreement on VR use is improving and assessing the clinical decision-making skills of the participants (32, 35, 36). It should be noted that VR is relatively a new method and to evaluate its effectiveness, the participants need to be well prepared for the method and need to have sufficient experience to prevent the results from the bias of being a new method.

Augmented reality is not as popular as VR in medical education, and it is usually used as an alternative to VR. There are limited studies on AR and one of them suggested that AR would work more useful if seniors use it because of its decompensated environment (37). The disadvantage of AR is that it adds things to the real environment. So, it is not cost-effective because it still needs traditional environments (23).

The effectiveness of simulation-based education depends on how well it is conducted and used (1). The curriculum developers should have a clear understanding of aims and learning outcomes to select appropriate learning activities. The national core curriculum (NCC)-2020 in Turkey is recommended for use as a guide while developing undergraduate medical education (38). The National Core Curriculum-2020 contributes to an understanding of aims and learning outcomes in Turkey. It is known that technology-enhanced methods are superior to traditional teaching however, the use of simulation is limited for medical students compared with nursing students and residents (36). So, this field continues to improve for undergraduate medical education. This study aims to reveal adequate simulation methods for the topics in the National Core Curriculum-2020 and to present a tool for the selection of the appropriate simulation method.

Research questions:

1-What are the reflections of the simulation-based education in the National Core Curriculum-2020 in Turkey?

2-How can the National Core Curriculum-2020 enlighten the program developers for structuring a simulation-based education?

MATERIALS AND METHODS

Constructivism, which is defined as the worldview we give the meaning of the world, was adopted to conduct the study. The use of constructivism in the research methodology allows researchers to express their understanding of the data in accordance with their background (39). So, it is important to know the background of the researchers to clearly understand the study. In our study, one researcher was a medical educator with the lens of a theoretical background for simulation-based education and the second researcher was an experienced physician and also a senior resident in the Department of Emergency Medicine with the lens of a practical background of simulation-based education. These different perspectives of the researchers contributed to the richness of the results.

The literature review was conducted to deeply understand the principles of simulation-based education and was used as a guide to investigate the topics in the national core curriculum. The content analysis of the NCC-2020 was conducted to structure a tool for the simulation method selection criteria in undergraduate medical education. The Standards for Reporting Qualitative Research (SRQR) checklist was followed to ensure the quality of the study.

The National Core Curriculum is the main document for medical schools to ensure the quality of undergraduate medical education. The National Core Curriculum was first developed in 2000 to conduct a framework for the medical schools in Turkey. Its first revision was completed in 2014 after the commission of the deans of medical schools had been structured. The current version of the NCC was finalized in 2020 and it is agreed that all medical schools should structure their undergraduate medical curriculum according to the NCC (38). The National Core Curriculum Working Group is still working on the upcoming version of the NCC. So, the version of 2020 is still a valid and valuable instrument to follow. There are mainly three sections in the NCC-2020: 1- the competencies and sub-competencies, 2- the content of the competencies, and 3- the behavioral and social sciences and humanities. This study focuses on section two -which involves the symptoms/findings/situations, the core diseases/problems, and the basic medical practices- and section three in accordance with competencies and sub-competencies in section one (38).

The simulation methods were categorized according to their usage patterns rather than their fidelity level. Cost-effectiveness was the second criterion while considering a method for a topic. Finally, the methods that threaten the safety of the participants were considered as a last alternative. Familiarity with the method was not considered as a criterion because different faculty members could have different experiences with simulation methods. So, there is a need for training trainer programs repeatedly to ensure that all faculty members have the same level of knowledge and skills for the selected method.

Two researchers independently analysed the National Core Curriculum (NCC)-2020 and evaluated the topics relevant to simulation-based education. After investigating the NCC-2020 independently, they met repeatedly to get to a consensus about the topics they considered adequate for simulation-based education. Then they matched the simulation methods for each topic in the NCC-2020 independently. Finally, they met repeatedly to get to a consensus on the order of the alternatives for each topic. Three expert opinions were taken for the appropriateness of the simulation method for each topic presented in the tool. Table 1 shows the details of the tool.

The ethical approval was not applicable to this study based on the content analysis methodology.

RESULTS

There are technical and non-technical competencies which can be provided by simulation-based education. Several methods can be used according to the utilization of medical schools. A total of 20 number main skills were identified as suitable for simulation-based education and methods were matched with these skills with at least three alternatives. Table 1 shows the alternatives for selecting the adequate method.

Clinical decision-making was determined in the first and second sections of the NCC-2020. To diagnose a symptom/finding/situation adequately, clinical decision-making skills should be used. There were 141 symptoms/findings/situations and 342 core diseases/problems in NCC-2020. Each of them can be structured by simulation-based education in addition to theoretical education. Clinical decision-making skills are considered to be structured in the same simulation methods. So, there is only one clinical decision-making line in Table 1 which represents all of the clinical decision-making situations.

Related Competency in National Core Curriculum	Main skill	Recommended Simulation Method 1	Recommended Simulation Method 2	Recommended Simulation Method 3	Level of medical students
Medical expert Competency 1	Clinical reasoning	Wearable simulator + simulated participant	High-fidelity mannequin	Virtual reality	Year 3,4,5,6
	Clinical skills -History taking	Simulated participant with or without wearable simulator	High-fidelity mannequins	Virtual reality	Year 1,2,3,4
	Clinical skills -Physical examination	Simulated participant with or without wearable simulator	High-fidelity mannequins	Task trainers with or without virtual reality	Year 3,4,5,6
	Clinical skills -Recording and reporting	Medium/Low fidelity mannequin and facilitator	Simulated participant with/without facilitator	Virtual reality	Year 3,4,5,6
	Clinical skills -Applications about laboratory	Simulated participant with/without facilitator	Medium/Low fidelity mannequin and facilitator	Virtual reality	Year 3,4,5,6
	Clinical skills -Invasive applications	Medium/Low fidelity mannequin and facilitator	Wearable simulator + simulated participant	High-fidelity mannequins	Year 3,4,5,6
	Clinical skills -Noninvasive applications	Simulated participant with or without wearable simulator	High fidelity mannequin and facilitator	Virtual reality	Year 3,4,5,6
	Clinical skills -Preventative medicine	Simulated participant	High fidelity simulator with voice response	Virtual reality	Year 3,4,5,6
	Clinical skills -Healthiness	Simulated participant	Medium/Low fidelity mannequin and facilitator	Virtual reality	Year 3,4,5,6
	Clinical skills -Scanning	Simulated participant	Medium/Low fidelity mannequin and facilitator	Virtual reality	Year 3,4,5,6
Ethics and professionalism Competency 2	Apply good medical practices	Simulated participant	High fidelity mannequin with voice response	Virtual reality	Year 4,5,6
	Fulfils her/his duties within legal rights and liabilities	Medium/Low fidelity mannequin and facilitator	Simulated participant with/without facilitator	Virtual reality	Year 4,5,6
Health advocate Competency 3	Manages the process (healthcare service, training, and supervising the individuals and community) for improving health.	Medium/Low fidelity mannequin and facilitator	Simulated participant with/without facilitator	Virtual reality	Year 4,5,6

Leader-Manager Competency 4	Shows adequate leadership	Simulated participant and facilitators	Medium/Low fidelity mannequin and facilitators	Virtual reality	Year 4,5,6
Team member Competency 5	Shows interprofessional competency	Medium/Low fidelity mannequin and facilitators	Simulated participant and facilitators	Virtual reality	Year 4,5,6
Communicator Competency 6	Effectively communicate with patients and their relatives	Simulated participant	High fidelity simulator with voice response	Virtual reality	Year 1,2,3,4,5,6
	Effectively communicates patients with special needs and different sociocultural backgrounds	Simulated participant with or without wearable simulator	High fidelity simulator with voice response	Virtual reality	Year 1,2,3,4,5,6
	Involves patient in decision making process	Simulated participant	High fidelity simulator with voice response	Virtual reality	Year 1,2,3,4,5,6
Scholar Competency 7	Embraces evidence-based approach	Medium/Low fidelity mannequin and facilitator	Simulated participant and facilitator	Virtual reality	Year 3,4,5,6
Lifelong learner Competency 8	Manage her/his own learning process	Facilitator(s)	Simulated participant and facilitator	Virtual reality	Year 1,2,3,4,5,6

ere were 157 basic practical skills (BPS) in NCC-2020. They were categorized into nine subheadings. The invasive and non-invasive applications subheading was divided into two to ensure the clarity of the selected simulation methods. The "scientific research principles and practices" subheading couldn't match with any simulation method and was excluded from the study. In conclusion, there were nine main categories for the BPS section. In order to match BPS with adequate simulation methods, each of these nine subheadings was considered as one type of main skill. Table 1 shows the details of these nine main skills related to the BPS.

The behavioral and social sciences and humanities section (section three) was evaluated according to their relation with competencies in section one. For example, the "Communication problems" subheading was considered a component of the competency of "Communicator". There were 10 main skills associated with simulation methods in this category. Table 1 shows the details of these 10 main skills related to section three.

DISCUSSION

The selection criteria for simulation methods is based on the context of each medical school (40). High-fidelity mannequins, which are the dominant component of traditional methods, are more complicated and capable than their first versions. Thus, they provide a great opportunity to gain experiences in clinical-like environments for medical students (4, 32). In our study, high-fidelity mannequins can be seen as a great alternative, especially the skills which do not require human interaction like communication.

Extended reality (VR and AR) is seen as a major alternative to traditional methods (11). While using VR, the limitation of training on psychomotor skills is tended to underestimated and it is mostly recommended to use traditional methods (before or after VR) to compensate for this limitation (25). On the other hand, high-fidelity simulators and SPs in traditional methods are safer for participants than VR and AR considering the dizziness etc. they cause (32). Due to these limitations, extended reality was considered the last alternative in our study.

The simulated participant method is a great alternative, especially for the skills that need human interaction (12). Wearable simulators + SPs method is more reasonable than traditional mannequins when considering the level of resembling real patient interaction (29). In our study, we highly recommended the simulated participant method for non-technical skills independent that non-technical skills were combined with technical skills or not.

Task trainers as a low-fidelity traditional method, maintain its importance and stand at the core of the simulation-based education for technical clinical skills training (14, 15). In our study, we recommended low-fidelity simulators as a common alternative, especially for technical skills.

The tool we conducted covers basic to complicated simulation methods which every medical school can adopt according to their facilities. We recommend our tool as a guide in selecting adequate resources while developing simulation-based education in undergraduate medical education.

One of the limitations of the study is that our study focuses on undergraduate medical education and the National Core Curriculum-2020. Thus, the tool is not structured for postgraduate medical education. Still, there are common skills in undergraduate and postgraduate medical education which can be structured in the same way. Another limitation is that this study only analyzed the core curriculum that is unique to Turkey. Although the general trends in medical education in Turkey are based on the World Federation for Medical Education (WFME), the documents of WFME were not analyzed in our study.

A source regarding which simulation method is selected for which skill by medical faculties could not be found in the literature review. Further research about the simulation centers' preferences for selection simulation methods in their programs should be conducted to understand the feasibility of each method.

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Abbreviations list

AR: Augmented Reality
VR: Virtual Reality
SP: Simulated Participant
NCC: National Core Curriculum
SRQR: Standards for Reporting Qualitative Research
BPS: Basic Practical Skills
WFME: World Federation for Medical Education

Ethics approval and consent to participate

The ethical approval was not applicable to this study

based on the content analysis methodology.

Consent for publication

Our study is based on content analysis of the document. It does not contain any personal data.

Availability of data and materials

Data from the study were not stored digitally or physically.

Competing interests

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