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Perceptions and attitudes of undergraduate medical students regarding the use of the simulation-based learning model: a mixed study.

Percepciones y actitudes de alumnos de la licenciatura en medicina sobre el uso del modelo de aprendizaje basado en simulación: un estudio mixto.

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Abstract: Introduction: The Simulation-Based Learning Model used in medical education is a tool that has contributed to the acquisition of clinical competencies and doctor-patient communication skills in students, promoting optimal knowledge and greater confidence in the execution of skills and abilities, clinical reasoning, critical thinking, leadership and teamwork when performing medical procedures with real patients, minimizing iatrogenesis and incompetence. An aspect that has not been evaluated enough is the perceptions and attitudes of students towards this model, which can help to understand how the experience of the model is in undergraduate medical students. Methods: A study was conducted with 354 students from 1st to 9th semester of medicine at UVM Zapopan. A survey was conducted to obtain information on how they evaluate their experience with the model. 25 of these participants were selected to conduct a semi-structured interview to delve deeper into their perceptions and attitudes. Results: 83% identify the Simulation-Based Educational Model and consider it of great importance for their training, 8 out of 10 respondents report having greater self-confidence and 81% improve their clinical skills and abilities. From the qualitative interviews, 5 central themes were identified: experiences in class, learning, development of self-confidence, advantages and limitations and suggestions, in general, evaluated positively; however, the perception is ambivalent in self-confidence. Conclusion: The transition to a simulation-based model is well accepted and achieves an adequate development of competencies.

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survey was conducted to obtain information on how they evaluated their experience with the model. 25 of these participants were selected to conduct a semi-structured interview to delve deeper into their perceptions and attitudes. Results: 83% identify the Simulation-Based Educational Model and also consider it of great importance for their training, 8 out of 10 respondents report having greater self-confidence and 81% improve their clinical skills and abilities. From the qualitative interviews, 5 central themes were identified: experiences in class, learning, development of self-confidence, advantages and limitations and suggestions, in general, evaluated positively; However, the perception is ambivalent in self-confidence. Conclusion: The transition to a simulation-based model is well accepted and achieves an adequate development of competencies.

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1. Introduction

Medical education has evolved in recent decades, moving from a traditional model to an innovative one based on simulated learning, whose objective is to raise the quality of teaching and develop professional skills (1). The term "simulation", which comes from the The Latin "similis" (to replicate), refers to imitation or representation. The Simulation-Based Learning Model (SBM) focuses on education, assessment, research and patient safety (2). To do this, it uses techniques that replicate real-life procedures, providing personalized learning. Their main objectives are to prevent iatrogenesis, reduce incompetence and develop clinical skills and abilities.

An innovative strategy in clinical simulation is the use of Artificial Intelligence, which has contributed to the consolidation of simulation as a teaching tool (3). In addition, clinical simulation practices promote critical thinking and autonomous learning, the ability to reflect and communication skills in undergraduate students (4-6). Likewise, various studies have shown that it provides greater security in students, speeds up and improves the experience, since everyone practices the procedure until they master the skill. For example, effectiveness has been demonstrated in the development of skills and abilities in obstetric procedures (7), bronchoscopy (8), mechanical ventilation, cardiopulmonary resuscitation and laparoscopy (9).

More and more universities in Mexico are adopting MABS as part of medical education, changing from a traditional system to a system where the student is proactive in developing their skills through the use of clinical simulation. However, although there are studies that have evaluated knowledge, skills development and reasoning in students based on the application of MABS (10), little is known about their experiences, perceptions, beliefs and attitudes. The importance of exploring these dimensions lies in the fact that they are dimensions that allow for significant learning (11), in addition to evaluating the quality of teaching-learning from the students' perspective. For all the above reasons, the present research aimed to analyze the perceptions and attitudes of medical students from a private university in Mexico regarding the simulation learning model.

2. Methods

A mixed study was conducted at the University of the Valley of Mexico, Zapopan Campus in Guadalajara, Mexico, with students of the Bachelor of Medicine; it was divided into two phases: a quantitative and qualitative phase, after the informed consent was accepted by the participants. The first quantitative phase was a descriptive cross-sectional design. Through convenience sampling, 354 students were selected. The inclusion criteria were: active students in 2019 and who were in their 1st to 9th semester. The exclusion criteria were: students in undergraduate internship, social service, or who were not in a semester in 2019. Elimination criteria: not answering the instrument completely.

A Likert scale was applied to measure attitudes and the instrument was constructed from the literature review and the research objectives; it measured four areas: attitude towards the model, development of competencies, self-confidence and the evaluation of simulation classes. The items of these four areas were focused on knowing the perception and favorable or unfavorable attitude of the students with respect to the MABS. A frequency analysis and central tendency measures were performed.

The second qualitative phase was narrative in design, using a purposive sampling. Twenty-five students who had participated in the first phase were included. Students who showed a favorable, unfavorable, and neutral attitude were selected to gather all kinds of perspectives. A semi-structured interview was applied to explore how they define the simulation, how they believe it helps them in their training, and to understand why they have a favorable or unfavorable perception and attitude. The interviews were recorded, with their consent, and transcribed in a word processor. They were later stored in the Ethnograph v6 software. A thematic content analysis was performed, which consisted of reading the transcripts, line by line, to identify the common thematic elements and code them. After preliminary coding, the codes that shared characteristics on a specific topic were grouped and the central themes and subthemes were developed from them. All participants were asked for their informed consent and the anonymity and confidentiality of the data was maintained.

3. Results

A total of 354 students were surveyed, and their ages ranged from 17 to 33 years, with an average age of 21 years, being 131 men and 223 women. All of them were taking different subjects based on the MABS using low, medium and high fidelity simulators. Of the total number of participating students, 298 (84.32%) reported knowing and identifying the components of the MABS. In general, they have a favorable attitude towards the model, with an average of 4.06 on a scale of 5 (Table 1). However, 81.36% of the students mentioned that the combination of practices with the MABS and the execution of procedures on living beings has been essential for the acquisition of skills and abilities during their medical training. 74.29% of students reported that the use of simulators in teaching improves their clinical skills and abilities, 85.06% considered that it contributes to the prevention of medical errors and 83.05% indicated that it improves critical reasoning in decision making in real scenarios. However, more than half (64.12%) considered that no matter how many simulation practices they do, it will not be enough to acquire the necessary security and skills until they perform it with real patients. Eight out of 10 respondents reported having greater self-confidence from the use of simulators and greater experience in the development of medical procedures. 68. 64% of students reported that the practices are of quality and 57.91% mention that the number of simulation practices is sufficient; 77.96% reported being satisfied with the teaching techniques of the teachers in simulation.

Content analysis. Five central themes were identified from the qualitative interviews (Table 2):

1. Classroom experiences. In general, they evaluated the classes and their teachers positively. They perceived that they had acquired knowledge about anatomical and pathological aspects, as well as the development of skills such as examination and interviewing the patient. In addition, they considered that it fostered a greater development of clinical reasoning. However, they recognized that there are factors that can affect class performance, such as not reading the pre-class materials in advance, lack of attention, or in some cases, a lack of clarity on the part of the teacher regarding the objectives of the practice.

2. Development of self-confidence. The students' perception is ambivalent. On the one hand, they consider that they have developed greater self-confidence and skills through continuous practice in simulation, but at the same time they consider that there are differences when performing procedures with real patients, which makes them doubt the skills acquired.

3. Advantages. They consider simulation in medical training to be important and perceive repeating procedures with the teacher's advice as an advantage. They believe that it is better to make mistakes in their simulation practices than with a real patient, and they say that it is a "plus" compared to training at other universities.

4. Limitations. They perceive practicing with their peers as a limitation because they have the opportunity to agree on what each one is going to do. They also sometimes feel that they don't know if they are doing the practice well or if they are doing something that could hurt the patient. In some courses they have little time or there are many students, which does not allow them to practice for the time they consider necessary.

5. Suggestions: Conduct classes with smaller groups of students, so that everyone has a better chance of practicing at ease, while allowing the teacher to evaluate each student in detail. They also suggest extending the class hours for the practical component.

4. Discussion

The objective of this work was to analyze the perceptions and attitudes of medical students from a private university in Mexico regarding the simulation learning model. The results obtained in the quantitative analysis corroborate the influence of the model in the preparation of medical students, who have adequate knowledge of the simulation model and also perceive it, in their great majority, as a favorable factor in the early development of competencies, as well as self-confidence; on the other hand, the qualitative analysis shows that students consider MABS important in their education, they perceive it as a developer of knowledge and skills through constant testing. These results agree with those obtained by Rodríguez-Díez et al. (7) and Corvetto et al. (13) who refer to the importance of MABS in improving knowledge acquisition, knowledge skills, collaborative work and a decrease in stress during the performance of procedures. Likewise, other studies have shown that the pedagogical approach of simulation accelerates the learning process and increases its quality, familiarization and standardization since it uses error as part of learning. It benefits the student by practicing clinical situations several times, acquiring and retaining knowledge, allowing the practice of invasive procedures and acquiring greater self-confidence (14-15).

A relevant aspect in this study is self-confidence, which in both types of analysis has an ambivalent result, since students refer to the need for in vivo tests or that when performing procedures on a real patient there are variables that were not considered in the tests. This raises the need for studies under the same variables and with greater depth by exploring the origin of such perceptions to develop strategies that allow improving the learning experience through MABS. Primiciani et al. (16) demonstrated that simulation is an educational tool for medical residents, which increases awareness of their biases when performing clinical procedures. Other studies have also demonstrated an increase in the level of confidence in the post-simulation evaluation (17), have identified that it improves clinical skills, which strengthens confidence when performing medical procedures (18), and is a useful tool in the development of critical thinking in students when making decisions (19-20).

Some limitations of the study are that the study was conducted at a single university, so it would be interesting to make a comparison between other universities. Nor are the skills acquired in a real clinical environment assessed. For future studies, a comparison can be made between students who took the MABS in their training compared to students who did not take the MABS in their academic training, to assess self-confidence and the acquisition of clinical skills, which will allow us to know, measure and evaluate the effectiveness of this model by comparing both groups. Likewise, it is suggested to carry out studies including the perspective of teachers.

Mixed studies can explore in a more precise way and expand the experience of students with MABS, which contributes to the knowledge that is already known about the effectiveness of this model and its eventual use in the different degrees that train bachelor's and postgraduate degrees in the health area, which results in better medical skills in these professionals, improving clinical skills that contribute to a better clinical diagnosis in patients. This work contributed to exploring the experience of students with MABS, giving a broader perspective of the importance and effectiveness of this model in medical education.

Table 1. Student responses to Likert-type items

COMPONENT	ITEMS	RELATIVE FREQUENCY*	TOTALS BY ATTITUDE TYPE**	Mean	P level (95.0%)
EDUCATIONAL MODEL	1. I identify the components of the educational model of the UVM Bachelor of Medicine	1= 0%, 2= 1.69% 3= 15.54% 4= 45.48% 5= 37.29%	1-2= 1.69% 3= 15.54% 4-5= 82.77%	4.18	0.078
	2. I know the Simulation-Based Learning Model	1= 0.28% 2= 0.56% 3= 13.28% 4= 42.37% 5= 43.50%	1-2= 0.84% 3= 13.28% 4-5= 85.87%	4.28	0.077
	3. I consider simulation to be a useful teaching method for my training as a doctor	1= 1.13% 2= 1.69% 3= 9.89% 4= 25.14% 5= 62.15%	1-2= 2.82% 3= 9.89% 4-5= 87.29%	4.45	0.087
	4. The development of practices on living beings is not essential to acquire the skills and abilities during my basic training as a doctor.	1= 22.8% 2= 17.23% 3= 27.12% 4= 19.21% 5= 13.56%	1-2= 40.03% 3= 27.12% 4-5= 32.77%	2.83	0.140
SKILLS DEVELOPMENT	5. Practicing with simulators (mannequins) improves my clinical skills and abilities	1= 0.85% 2= 3.95% 3= 17.51% 4= 34.18% 5= 43.50%	1-2= 4.8% 3= 17.51% 4-5= 77.68%	4.16	0.095
	6. Simulation practices help me prevent errors in the real clinical environment	1= 0.85% 2= 4.24% 3= 9.32% 4= 26.84% 5= 58.76%	1-2= 5.09% 3= 9.32% 4-5= 85.06%	4.38	0.092
	7. Practicing with simulation models helps prepare me to perform higher quality clinical procedures than clinical experience alone.	1= 2.26% 2= 3.67% 3= 12.71% 4= 30.23% 5= 51.13%	1-2= 5.93% 3= 12.71% 4-5= 81.36%	4.24	0.101
	8. My experience with simulation has improved my technical skills	1= 1.41% 2= 4.24% 3= 12.43% 4= 38.42% 5= 43.50%	1-2=5.65% 3= 12.43% 4-5= 81.92%	4.18	0.095
	9. Simulation helps me develop critical reasoning and medical decision making	1= 0.28% 2= 3.11% 3= 13.56% 4= 39.83% 5= 43.22%	1-2= 3.39% 3= 13.56% 4-5= 83.05%	4.23	0.085
	10. Performing clinical procedures in simulation makes me feel more self-confident	1= 0.85% 2= 5.08% 3= 12.15% 4= 31.92% 5= 50.00%	1-2= 5.93% 3= 12.15% 4-5= 81.92%	4.25	0.096
	11. The simulation learning model helps me gain more experience in performing medical procedures	1= 1.41% 2= 3.39% 3= 14.12% 4= 34.46% 5= 46.61%	1-2= 4.8% 3= 14.12% 4-5= 81.07%	4.21	0.095
DEVELOPING	12. I feel satisfied with the skills and	1= 2.26% 2= 6.50% 3= 16.95% 4=	1-2= 8.76% 3= 16.95% 4-5=	3.99	0.104

	abilities I have acquired by learning through clinical simulation	38.70% 5= 35.59%	74.29%		
SELF-CONFIDENCE	13. I think that no matter how much practice I do in simulation, it will not be enough to acquire the necessary confidence and skills until I do it with real patients.	1= 4.80% 2= 13.56% 3= 17.51% 4= 27.40% 5= 36.72%	1-2= 18.36% 3= 17.51% 4-5= 64.12%	3.78	0.127
	14. Simulated practices help me integrate the theory and practice of the subjects	1= 0.56% 2= 3.67% 3= 10.17% 4= 37.85% 5= 47.74%	1-2= 4.23% 3= 10.17% 4-5= 85.59%	4.29	0.087
	15. The workshops with the simulator motivate me to continue learning	1= 0.56% 2= 5.37% 3= 10.73% 4= 36.44% 5= 46.89%	1-2= 5.93% 3= 10.73% 4-5= 83.33%	4.24	0.093
EVALUATION OF SIMULATION CLASSES	16. In simulation (Complex), it is useful to see your own recorded performances	1= 1.41% 2= 5.37% 3= 13.28% 4= 35.03% 5= 44.92%	1-2= 6.78% 3= 13.28% 4-5=79.95%	4.17	0.099
	17. The duration of the simulation practices is adequate for optimal learning	1= 5.08% 2= 15.54% 3= 14.97% 4= 34.75% 5= 29.66%	1-2= 20.62% 3= 14.97% 4-5= 64.41%	3.68	0.125
	18. I am satisfied with the teaching techniques of the teachers in simulation	1= 1.69% 2= 5.65% 3= 14.69% 4= 31.07% 5= 46.89%	1-2= 7.34% 3= 14.69% 4-5= 77.96%	4.16	0.103
	19. I consider that the number of practices carried out in simulation are sufficient	1= 8.76% 2= 14.69% 3= 18.64% 4= 30.23% 5= 27.68%	1-2= 23.45% 3= 18.64% 4-5=57.91%	3.53	0.133
	20. The practices carried out in simulation are of high quality]	1= 3.11% 2= 5.37% 3= 22.88% 4= 28.81% 5= 39.83%	1-2= 8.48% 3= 22.88% 4-5= 68.64%	3.97	0.111
TOTAL AVERAGE				**4.06**	

*, * 1 Totally disagree and 5 Totally agree; **1-2 = unfavorable attitude, 3= neutral attitude and 4-5= favorable attitude

Table 2. Themes and illustrative quotes.

Topics	Quotes
Classroom experiences	*"I also acquire the knowledge that we are told is correct and that this is how it should be done and that this is the right thing to do."* *"If you know how to take advantage of it and… Likewise, if you have a teacher who knows how to take advantage of it, it is very enriching" (MABS)* *"They have very good teaching staff and they also have good facilities"* *"Well, there are many factors (for which there are difficulties in class), for example, one on the part of the student who has not read before or studied before… I tell you this from my experience… Another of what… the truth is that sometimes, mmm, it seems that one does not pay much attention to the doctor, to his explanation and well, there too, it seems that the thread of the class is lost and well, the other… mmm, as for example the classmate does not lend himself to doing that practice"* *"You learn a lot from it and there are also others where you don't even find out what or why you went, you don't find the objective of that practice"* *"At first I didn't see the point, because I thought, well, it's better to practice with people than with mannequins or something like that, but as time went by I understood that it's better to make mistakes here many times with a mannequin than to hurt people, so I do like the model."*
Developing self-confidence	*"Before, I used to get very nervous, honestly… by asking the patient and simulating between us, it is more fluid, I already know what to ask, I already know where to ask or how to deal with him"* *"For example, a topic of appendicitis in the physical examination to arrive at the diagnosis, ehh, asking the patient about the pain and you exploring it, the exploration maneuvers here were taught to us, then once in the clinical field a patient arrived, and the doctor told me "examine him", he arrived with the appendicitis clinic, if I did the maneuvers and everything was positive and the appendicitis came out positive"* *"What I have already learned I feel self-sufficient to execute them, but I still continue to learn new things every day"* *"Because you already know how to do it, you practiced it several times, but you don't know if… if when you do it on a patient it will be correct as you did on a mannequin or on a colleague, in which case you didn't identify anything abnormal, but here in the mannequin… the truth is I don't know if the pathology feels exaggerated."* *"Enriching, but… I… I have doubts that sometimes one doesn't know if one is really… having the necessary experience"*
Advantages	*"You know palpation, you know how to inspect, and I think you come with a broader mind and reasoning than someone who has not undergone simulation."* *"It has the value of ethics, which is why they avoid using corpses, animals or even practicing with partners"* *"Because it is the base (the MABS), it is this… the foundations to then have a good real practice… because in the simulation you already saw the techniques, the bases, also theory and well that set of things that you saw before are what lead you to… to do it well or to do it badly"* *"I think simulation is important in medical schools to avoid making money off of patients and to know how to take the right approach."* *"Well, the practice you do there, you can try it 1-2-3-4-5 times and it is easier… you always have advice"* *"Well, I like it because we apply what we learn in literature and the doctors tell us whether it is done or not or how it is done better or the techniques that they already have and they correct us and we have the chance to practice with ourselves, or with the mannequins or the material."*
Limitations	*"Just like working with models, having on the other hand learning a little more… more real, closer to reality with your peers"* *"The patient experience because many things that are done in… in a mannequin you do them, but you don't know if it hurts, if you are doing it well, yes… yes… if you are really doing a good practice because you are not having that expression from the patient"*

	"Although in simulation there are also… how do you say it? differences with a real patient" *"To begin with, it is already planned, you agree with your colleagues about who is going to be who… who is going to do each thing, the patient they are going to have and so obviously the one who has to be the doctor, well, he already knows what… what it is, so it is not like that, what are you reasoning about what you are saying, what are you thinking because you already know that the patient is going to arrive as if taking and so you are going to say "ah, he has this" I feel that in that part of… of acting out the consultations, well… you do not reason at all"* *"Regarding palpation simulation models, exploration, etc., as I mentioned, the structures are very clear or sometimes they are not even there and that is omitted and well now it is practice and I think it is good to do it for the first time there, but if with that you can already go out to give your official consultation there I would be a little bit… scared to do it."* *"Right now, in the simulation that we have in this eighth semester, the time seems very short to me and I feel that we cannot take advantage of it as much because we are only given one hour of simulation and we are large groups and we do not take full advantage of it."*
Suggestions	*"To start with, there should be slightly smaller groups, because many times in large groups you have to work with large teams, you do it in a hurry, you do it in a hurry, and sometimes you don't have to consult with the teacher about what is rotating, and that's not up to you, since the teacher doesn't have to be present, mmm... another thing is that there are models that are already a little bit damaged and so they have to be changed or they don't even come out at all."* *"Well, regarding the simulation time that was given to us, I would like to see it extended a little more so that we can take full advantage of it because time seems very short to me and everything has to be rushed and it is like a bit of a mess of what is important and it seems to me that one does have to develop the skill well and so on."*

5. Conclusions

- A majority of students identify the Simulation-Based Educational Model and consider it of great importance for their training, since it increases their self-confidence and improves their clinical skills and abilities.
- From the qualitative interviews, five central themes were identified: experiences in class, learning, development of self-confidence, advantages/limitations and suggestions; in general, they were evaluated positively, however, the perception is ambivalent in terms of self-confidence.
- The transition to a simulation-based model is well accepted and achieves adequate development of skills.

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