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Metacognition in clinical simulation: metacognitive events during briefing, simulated practice, and debriefing

Metacognição na simulação clínica: eventos metacognitivos durante o briefing*, a prática simulada e o* debriefing

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ABSTRACT

Introduction: Clinical simulation involves various cognitive and metacognitive processes. However, metacognition, although present, is often neither valued by educators nor recognized by students. Identifying and mastering metacognition transforms learning, enhances simulation performance, and improves the training of future physicians, making them better prepared for complex care scenarios.

Objective: To identify, classify, and describe whether and how the metacognitive process occurs in clinical simulation.

Method: This is an observational, longitudinal, descriptive, and qualitative study conducted with medical students in the state of Paraná, Brazil. Data collection involved 16 clinical simulations across two curricular units throughout the semester, resulting in a field diary. The diary was analyzed using theoretical metacognitive categories and the emergence of empirical categories.

Results: The types of events identified were categorized into metacognitive knowledge (40.7%), metacognitive skills (30.3%), and metacognitive experiences (29%). Regarding subtypes of events, most occurrences were of task-type metacognitive knowledge (61.8%), especially during the simulated practice stage, highlighting intense retrieval of prior knowledge and the need for decision-making aligned with the objectives. For metacognitive skills, the most prevalent type of event was evaluation (45.7%), indicating a focus on selecting subsequent actions after clinical reasoning. In terms of metacognitive experiences, most events involved a sense of difficulty (71.5%), mainly during the debriefing stage, revealing low familiarity (3.9%) and confidence (14.7%).

Conclusion: The study describes and measures the presence of metacognition across the three stages of clinical simulation. Furthermore, it analyzes how metacognitive events are influenced by external factors that promote the explicit manifestation of metacognition, particularly through participant discourse. The results highlight the central role of conflicts and leadership in the metacognitive dynamic, demonstrating how these factors shape interactions, self-regulation, and the development of metacognitive competencies in the simulation context. Thus, the study reinforces the importance of metacognition in enhancing learning through clinical simulation and provides insights for improving this educational strategy.

Keywords: Metacognition; simulation-based training; learning.

RESUMO

Introdução: *A simulação clínica envolve diversos processos cognitivos e metacognitivos. No entanto, a metacognição, embora presente, muitas vezes não é valorizada pelos docentes nem reconhecida pelos discentes. Identificar a metacognição e apropriar-se dela transforma a aprendizagem, melhora o desempenho em simulações e aprimora a formação do futuro médico, tornando-o mais preparado para atendimentos complexos.*

Objetivo: *Este estudo teve como objetivos identificar, classificar e descrever se e como o processo metacognitivo ocorre na simulação clínica.*

Método: *Trata-se de um estudo observacional, longitudinal, descritivo e qualitativo, realizado com acadêmicos de Medicina no estado do Paraná. Na coleta de dados, foram acompanhadas 16 simulações clínicas de duas unidades curriculares, ao longo de todo o semestre, dando origem a um diário de campo. Este foi analisado a partir do uso de categorias teóricas metacognitivas e pelo afloramento de categorias empíricas.*

Resultado: *Os tipos de eventos localizados foram categorizados em conhecimento metacognitivo (40,7%), habilidades metacognitiva (30,3%) e experiência metacognitiva (29%). Referente aos subtipos de eventos, a maioria das ocorrências foi de conhecimento metacognitivo do tipo tarefa (61,8%), em especial na etapa de prática simulada, apontando intensa recuperação de conhecimento prévio e necessidade de tomada de decisão alinhada ao objetivo. Sobre a habilidade metacognitiva, o tipo de evento mais prevalente foi a avaliação (45,7%), o que denota preocupação com a escolha de condutas posteriores ao raciocínio clínico. No que concerne às experiências metacognitivas, a maioria dos eventos foi do tipo sentimento de dificuldade (71,5%), com manifestação principalmente na etapa do debriefing, além de apontar pouca familiaridade (3,9%) e confiança (14,7%).*

Conclusão: *O estudo descreve e mensura a presença da metacognição ao longo das três etapas da simulação clínica. Além disso, analisa como eventos metacognitivos são influenciados por fatores externos que promovem a manifestação explícita da metacognição, especialmente por meio do discurso dos participantes. Os resultados destacam o papel central de conflitos e liderança na dinâmica metacognitiva, evidenciando como esses fatores moldam as interações, a autorregulação e o desenvolvimento de competências metacognitivas no contexto da simulação. Dessa forma, o estudo reforça a relevância da metacognição no aprimoramento do aprendizado com simulação clínica e aponta caminhos para o aperfeiçoamento dessa estratégia educacional.*

Palavras-chave: *Metacognição; Treinamento por Simulação; Aprendizagem.*

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INTRODUCTION

Clinical simulation is an approach that seeks to reproduce scenarios similar to those found in the context of health care practice, aiming to instruct both technical and interpersonal skills. Its objective is to stimulate participant involvement, influence changes in mentality and facilitate the practical application of the acquired knowledge[1].

This procedure has shown efficacy in health education and is constantly being improved[2]. It is currently divided into three major stages: Briefing (1), which consists in inserting the student in the scenario and establishing the cognitive act of surrender to the scenario, called "reality contract"[3-4]; Simulated Practice (2), which is the clinical simulation itself; and Debriefing (3), a moment in which all the attitudes, knowledge and skills manifested during the simulated practice are explored, promoted by the debate and reflections on the actions[2].

The simulation, especially the debriefing stage, allows a review of the attitudes, skills and knowledge used to solve the scenario through a deep reflection on the performed actions[5]. For this purpose, the student needs to recognize what was necessary to solve the problems and how they used their own cognition to achieve the learning objective.

However, it is observed that, at least in the currently used protocols, there is no stimulus to become aware of the use of such cognitive processes, that is, the student is not encouraged to use metacognition. It is as if it did not exist, or if it did, it had no educational value and when mentioned it is only related to technical aspects. However, according to Peixoto and Silva[6], knowing our cognitions is the first step to develop metacognition and use it strategically to enhance learning.

The benefit of recognizing metacognitive processes during clinical simulation allows reaching a second level of cognition, acting as a learning transformer. It is worth mentioning that the apprentice is being trained to treat complex individuals. Then, academic learning will prepare them to act with greater competence and security. Our hypothesis is that stimulating the use of metacognition is an important tool to promote reflection and improve the training expected of future health professionals, making them increasingly more competent[6].

When the subject understands the way in which they learn, they expand their capacity to construct knowledge; because they identify their gaps and limitations, which allows developing strategies to overcome them. In this sense, metacognition becomes an instrument capable of promoting self-awareness, favoring the learning process. It is precisely the performance of reflection that leads the subject to become aware, that is, to appropriate their actions. And, by appropriating their practice, they build or rebuild the structures of the individual way of thinking, expanding the capacity for understanding[6].

Metacognition is a broad topic explored in the context of clinical simulation[7-8-9]. However, studies tend to focus on the presence and its effects, often without delving into the forms of observation or the phenomenon complexity. However, while everyone agrees that there has to be something like 'metacognition' (like the Loch Ness monster?), no one agrees on what exactly metacognition is."[10] This metaphor highlights the importance of going beyond the simple verification of its existence, seeking to describe and analyze in detail its manifestation forms in the learning process.

In the literature, different methodological approaches, such as questionnaires[10], interviews[12] and other instruments[13], have been used to investigate metacognition. However, these approaches offer partial and fragmented views, making it difficult to build comprehensive models that articulate metacognition with the practice of clinical simulation. The creation of robust theoretical models requires a detailed description of metacognitive events, their context and their consequences, considering the complexity inherent to the phenomenon. From this perspective, it can be observed that the literature still has significant gaps, lacking more precise information on how students behave in relation to metacognition and what are the impacts of this behavior.

By exploring these interactions, the proposed approach demonstrates potential to make students aware of their own cognitive processes. This awareness allows students to mobilize their metacognitive resources in a more integrated and strategic way, directly impacting their academic and professional training. Thus, the detailed understanding of metacognition in the context of clinical simulation not only expands the possibilities of pedagogical intervention but also contributes to forming health professionals who are more reflective and prepared to deal with the complexity of practice.

Therefore, the aim of this study is to identify, classify and describe whether and how the metacognitive process occurs in clinical simulation.

METHOD

This is an observational, longitudinal, descriptive study of a predominantly qualitative nature. At times, numerical values were highlighted to reinforce the frequency of the studied events. It used the Consolidated Criteria for Reporting Qualitative Research (COREq) as a guide for qualitative research, following the translated and validated version of the 32-item checklist[14]. The methods employed in this study were developed as part of the research conducted for a doctoral thesis. The qualitative approach is justified by the context that

prioritizes aspects of individual reality and subjectivity, allowing the understanding of the subjects' attitudes and perceptions.

The research site was a Clinical Simulation Center (CSC) of a private college located in the capital city of the state of Paraná, Brazil. The simulations investigated in the study were applied in two curricular units. One entitled Medical and Communication Skills (HMC) - Life Support in Children and Adults, which focuses on cardiovascular emergencies. And the other, HMC - Support for Trauma Victims, aims at understanding the lesions caused by trauma. Both take place in the fifth and sixth semesters of the medical course, respectively.

The subjects' inclusion criteria were: a) being a medical student attending the fifth and sixth semesters, regularly enrolled in the curricular units "HMC – Life Support in Children and Adults" or "HMC – Support for trauma victims"; b) having a minimum participation of 75% in the face-to-face classes held at the institution CSC; and c) accept the invitation to participate in the research and sign the Informed Consent Form (ICF). The exclusion criteria in the planning phase of the study included: a) students who showed a behavior incompatible with the study or eliminated from classes by the teacher; and b) those who expressed the desire to interrupt their participation in the research. However, during the study, none of these criteria were observed.

Data collection occurred through records in field diaries during participants' observation in the clinical simulation scenarios of the semester. In this phase of the research, the metacognitive events that occurred throughout all stages of the clinical simulations were recorded, as well as other aspects that could improve the discussion of the topic.

The construction of the field diary was carried out in three stages to ensure the validity and reliability of the material, and the respective analyses. Preceding them, two pilot tests were successfully carried out to evaluate the suitability of the data collection and analysis process, which are not presented herein, nor were their results added to this study.

For the data collection and before the beginning of each scenario, in the stage called "Initial Impressions", the learning objectives proposed by the teachers, the assembly of the simulation room and the recognition of the inputs and resources used (mannequins, simulated actors, etc.) were recorded in the diary. The arrival of the students started the "Impressions of development" stage, and then the attention turned mainly to the students' speeches and to the discourses relevant to the metacognition context, with the recording of these interactions in real time with the use of a voice recorder and the observer's personal notes. After the end of the simulation, in the stage called "Final adjustments", additional aspects related to the scenarios were recorded, such as the group's interactions, the team's organization and the experienced problems; and the teacher was consulted to add information they deemed important.

As these notes demanded a lot of attention, it was decided to record a maximum of two scenarios per shift (ten minutes each), preventing that fatigue or distraction favored the recording of inadequate data.

Thirty students participated, 22 of them enrolled in the curricular unit HMC - Life Support in Children and Adults and the remaining 08 in the curricular unit HMC - Support for trauma victims. There were no dropouts or refusal to participate in the research. Sixteen simulation scenarios were monitored throughout the semester, identified by unique numbers for the purpose of organizing the material (C1 to C16).

The sample was selected by convenience, as we aimed to understand how this specific group manifested metacognition in simulation. Regarding the data saturation criterion adopted in this research, it is important to highlight that the focus of investigation was the metacognitive events that occurred during the clinical simulations. Therefore, despite the variations in the values from one scenario to the other, its repetition and the emergence of the pattern presented there were observed. Therefore, the collection was closed at the end of the 16 scenarios.

The content of the field diaries was processed using Categorical Content Analysis according to Bardin[15], to identify, organize and interpret the categories of interest of the study. This procedure was carried out in two stages. The first deductively used the metacognitive component itself to study the theoretical categories defined by Peixoto et al.[16] and Efklides[17]. In the second, in order to highlight the meanings of metacognitive events, the empirical categories were extracted inductively.

In the first case, the metacognitive events manifested consciously, according to the experienced situations, were identified in the discourses of the field diary. For the purposes of this study, metacognitive event was understood as "the occurrence, in the body of the message, of passages with characteristics such as to allow inferring some type of metacognitive activity"[18]. These were then classified into three types and their corresponding subtypes: Metacognitive Knowledge (MK) (task, people, goals, and strategies), Metacognitive Skill (MS) (prediction, planning, monitoring, and evaluation), and Metacognitive Experience (ME) (feeling of difficulty, familiarity, confidence, and knowledge)[16-17].

In the second, also focusing on the content of the field diaries, the empirical categories were constructed. For this purpose, the criterion used was semantic, that is, meaning and sense. Thus, in the interpretation of data, inference was used to create these categories.

The content analysis started with the pre-analysis, with floating reading, construction and preparation of the material. Then came exploration, where the discourses were coded in registration units[19]. For the first, the unit of registration was the excerpt of the discourse of sufficient length to characterize a metacognitive event. For the second, the excerpt from the discourse was considered, which, including one or more metacognitive events, allowed the expression of some empirical category. At this time, the enumeration also occurred, which observed the presence, absence and frequency of these units. For this purpose, the theoretical categories and their context were grouped using Microsoft Excel© software.

Regarding ethical aspects, the precepts contained in CNS Resolutions n. 466/2012 and 510/2016 were followed. This research was approved by the Research Ethics Committee (CEP) of Universidade Federal do Rio de Janeiro (UFRJ), under Opinion number 5.385.617. It is noteworthy that the signing of the ICF was preceded by its reading by the participants and clarification of any doubts and questions.

RESULTS

Thirty medical students participated in the study. The following table shows the participants' profile and data regarding age, sex and the course semester (enrolled curricular unit).

Most participants were female and the predominant age group was 21 years old. Most of them were enrolled in the curricular unit of the fifth semester, which deals with the topics related to cardiovascular and pediatric emergencies.

Identifying metacognitive events:

Three (0.8%) metacognitive events were found in the briefing, 199 (56.4%) during the simulated practice and 151 (42.8%) in the debriefing stage, totaling 353 metacognitive events.

The incidence of metacognitive events in the briefing stage is less than 1%, which is why it was little explored in this study. Another factor identified in the research refers to the number of metacognitive events during the simulated practice, which exceeded the number of events that occurred in the debriefing stage.

Graph 1 shows the distribution of metacognitive events in the analysis of the field diary, which occurred during the simulated practice and the debriefing stage.

Classifying metacognitive events:

The metacognitive event with the highest incidence was the MK, with 144 events restricted to the stages of simulated practice and debriefing. As for MS and ME, they showed lower numbers (107 and 102, respectively), occurring in all stages of the simulation (briefing, simulated practice and debriefing), with emphasis on the simulated practice stage.

There were only three metacognitive events in the briefing phase, one of them during scenario C3, categorized as ME feeling of difficulty and evidenced in the following discourse:

> *"I don't like being a leader, everyone stares and I feel afraid."*

The expression of fear associated with the lack of leadership competence may eventually trigger the thought of learning strategies for the development of this competence.

Metacognitive Knowledge (MK)

For the purposes of this study, metacognitive knowledge was defined as "... the declarative knowledge stored in memory, about cognitive skills and strategies, tasks, and even models of cognitive processes, such as memory, language, and so forth" [16].

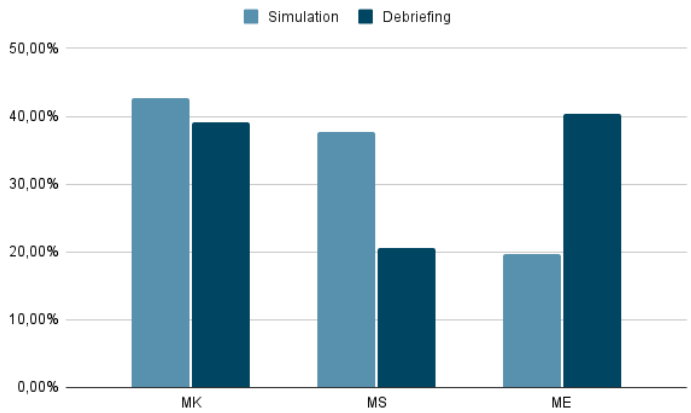
The MK on the Task was understood as the "MK that is mobilized during its performance and is represented

Table 1. Distribution of participants by sex, age and enrolled curricular unit.

Sex					
Female	17	56.7%	Male	13	43.3%
Age					
20 years old	1	3.3%	21 years old	12	40.0%
22 years old	8	26.7%	23 years old	2	6.7%
24 years old	4	13.3%	25 years or older	3	10.0%
Course Unit					
HMC 5	22	75.0%	HMC 6	8	25.0%

Source: Cordeiro[8].

Graph 1. Metacognitive events (MK, MS, and ME) in the simulated practice and debriefing stages.



Source: Cordeiro[8].

by the categories of tasks and their characteristics, the relationships between the tasks, as well as the ways in which they are processed"[16].

The MK on the Person is defined as the "Set of information on multiple strategies, as well as the respective conditions of use"[16]. That is, when, why, and how the strategy should be used.

In turn, the MK on the Metacognitive Strategy or Meta-knowledge is "second-hand knowledge about factual events of cognition and about strategies and/or procedures"[16].

Finally, the MK on Goals includes the "implicit or explicit objectives that drive, maintain and direct the cognitive enterprise aiming at the accomplishment of specific tasks or situations"[16]. For clarity, Chart 1 presents examples of these subtypes.

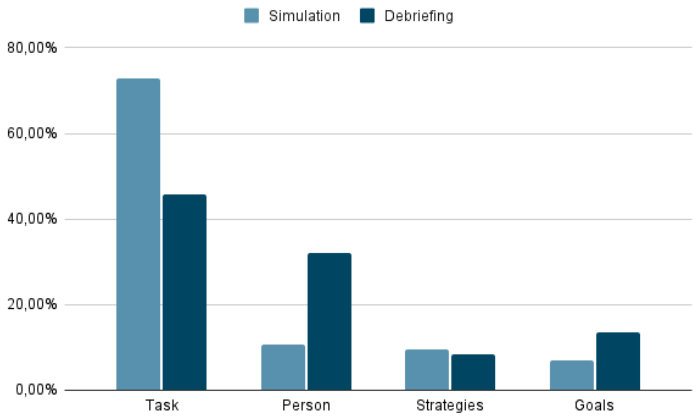
In the execution of the scenarios, MK was observed only in the simulation and *debriefing phases*, and in both phases the prevalent variable was the task type (62 and 27, respectively), which denotes the focus on the achievement of the objectives both in the practical performance and in the reflective debate of the final phase of the clinical simulation (Graph 2).

Metacognitive Skills (MS)

In the survey of metacognitive events, only three metacognitive events were observed in the briefing stage, manifested in scenarios S2, S3 and S13. Two were classified as a predictive MS (S2 and S13) and one as an ME, feeling of difficulty (S3).

The other phases of the clinical simulation, the simulated practice and the debriefing, include almost all the metacognitive events of MS, as shown in Graph 3. It shows the predominance of evaluation events, which represented almost 50% of the events, followed by monitoring, which refers to the apprentices' strong concern regarding executive control; however, it is a matter of concern due to the low evidence of prediction and planning events, that is, the preparation activities. As for the debriefing, a moment of reflection in the clinical simulation, the low number of these events in their entirety was surprising. The manifestation of these discourses can be observed in Chart 2, related to scenarios S2 and S3.

Graph 2. Number of MK and their subtypes: task, people, goals and strategies.



Source: Cordeiro[8].

Chart 1. Metacognitive events of the MK type identified in S1.

Scenario 1			
Stage	**Subtype**	**Metacognitive event**	**Event description**
SP	Task	**(1)** *"People remember in the baby that it is brachial, the rest is carotid".*	Accesses previous knowledge and applies it at the time of performing the task.
SP	*Task*	**(2)** *"I already know how to do it, I did it in the last skills class".*	Retrieves in memory and applies it while the task is being performed.
SP	*Person*	**(3)** *"It's 0.01 mg per kg, remember I want pediatrics, I study this a lot, trust me."*	The group attributes a higher trust value as they know that a member is more dedicated to that subject.
SP	*Task*	**(4)** *"Guys, it's one of the 5 Hs and 5 Ts, let's remember them all".*	It seeks to rescue in memory the resolution of the identified problem.
D	*Task*	**(5)** *"It is related to what I studied before, the PCR algorithm available in the VLE* (Virtual Learning Environment) *that gives the sequence, in which the service must occur"*	It recovers in memory, in the previous study, and seeks to apply the previously known relationship.
D	*Strategy*	**(6)** *"Therefore, in an emergency sector, assertiveness to delegate a function is necessary, we have to be very clear to reduce the chance of error, use this as a strategy".*	Due to the recognition of the characteristics of an emergency department, it employs strategies in order to reduce errors.
D	*Person*	**(7)** *"As we know each other, we know each other's weaknesses and strengths, and we try to complement each other."*	Recognizes and values the potential of each member of the group in solving the problem.

Source: Cordeiro[8].
Legend: SP -Simulated Practice; D - Debriefing; MK - Metacognitive knowledge.

Chart 2. Discourses classified as MS and its subtypes, during the simulation and debriefing stages.

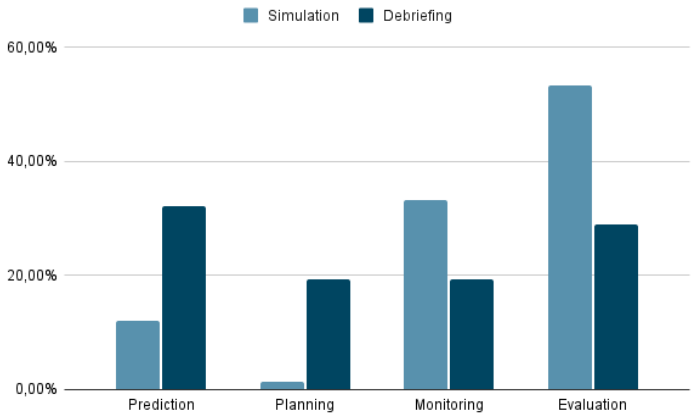
S2			
Stage	**Subtype**	**Metacognitive event**	**Event description**
SP	*Prediction*	**(6)** *"Guys, let's get organized, if not, it won't work."*	It predicts that without organization it will not be successful, which leads to change.
SP	*Evaluation*	**(7)** *"That's right, a straight line is equal to asystole and that's what the monitor is showing."*	It evaluates the new tracing, which leads its future action.
SP	*Prediction*	**(8)** *"Are you okay with access? Do you need help? I know it's not easy."*	Monitors whether the student who received the command for the access was successful.
D	*Monitoring*	**(9)** *"There was an initial error regarding the compression and ventilation ratio (30 compressions for two ventilations, which is indicated in adults), so we noticed it and changed it".*	Monitors performance throughout the chosen action, thus allowing one to correct errors.
D	*Planning*	**(10)***"In fact, it is necessary to plan and understand the priorities and intubation occurs at an opportune time, that's what we did".*	It recognizes the need to plan actions in emergency contexts, so that they are indicated with assertiveness and at the correct time.
S3			
Stage	**Subtype**	**Metacognitive event**	**Event description**
SP	*Monitoring*	**(11)** "*What may we have missed?"*	It observes that there is no improvement in the condition, which leads to the reflection of possible failures that may have occurred.
SP	*Evaluation*	**(12)** *"Calm down, no! The person has a pulse, the patient has returned."*	It evaluates the patient's new clinical condition before going "on automatic", which would be to continue with CPR.
D	*Evaluation*	**(13)** *"I would look for the signs and symptoms that caused the evolution, but the patient stopped in shockable (VF), that's what I identified, so it's okay for them to leave it aside, leave other signs aside, now the priority is the CPR".*	It evaluates the present moment, which allows one to set priorities.

Source: Cordeiro[8].
Legend: *S* - Scenario; *SP* -Simulated Practice; *D* - *Debriefing*; *MS* - Metacognitive skill.

Metacognitive Experiences (ME)

A total of 104 ME events were observed, considering the simulated practice and debriefing phases of the clinical simulation. There was a prevalence of the feeling of difficulty in both phases (28 in the simulated practice and 45 in the debriefing*);* the feeling of knowing was low, but equivalent in both phases (7 in the simulation and 5 in the debriefing*);* the feeling of confidence was highlighted only in the debriefing stage (4 in the simulation and 11 in the debriefing*)*; while the feeling of familiarity was very low, as it occurred only in the simulation (4 events) (Graph 4 and Chart 3).

Graph 3. Number of MS and subtypes: prediction, planning, monitoring and evaluation.



Source: Cordeiro[8].

The emergence of empirical categories:

During the analysis of the material, some empirical categories were identified. Metacognitive events were influenced by external factors that helped in the explicit manifestation of metacognition through the subjects' discourse. In this sense, we highlight two main aspects. First, the occurrence of conflicts throughout the scenarios, which often preceded and supported the metacognition manifestation. We defined conflicts as problems that required management by the team to be solved. Another relevant aspect was leadership, which, depending on how it was exercised, could support or hinder the occurrence of these metacognitive events.

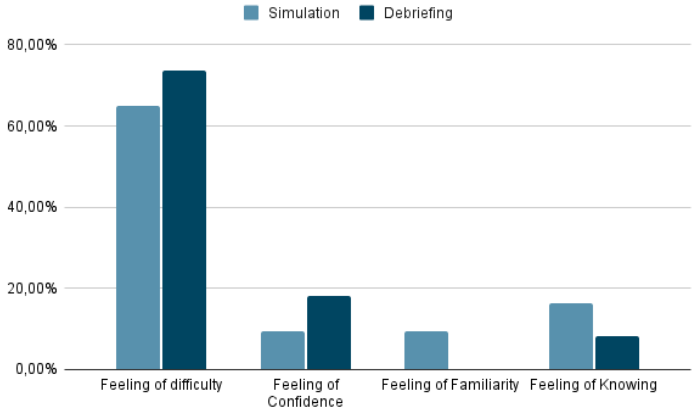
Regarding the first aspect, conflicts occurred in most scenarios, being more frequent in scenario S1, with the

occurrence of eight conflicts, followed by S3, S5, S8 and S14 with three events each; S2, S4, S6, S10, S13 with two; and S7, S9, S11 with one conflict each. Only scenarios S12, S15 and S16 did not show any conflicts during the simulation.

We observed that when conflicts arose, metacognition was required as a strategy for solving the problems. In most cases, the solution came from the use of MS (Figure 1), but MK was also used (Figure 2) in the solutions.

Figure 2 shows a student returning to the primary source of information to identify the cause of the problem. This process of constant search for information is essential to ensure quality and efficient medical care.

Graph 4. Number of ME and its subtypes: feeling of difficulty, familiarity, confidence and knowledge.



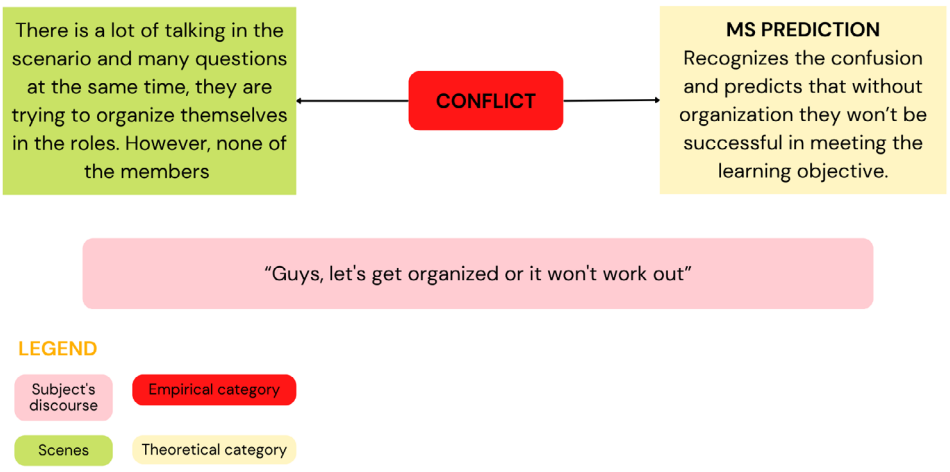
Source: Cordeiro[8].

Chart 3. Discourses identified and classified as ME.

S1			
Stage	**Subtype**	**Metacognitive event**	**Event description**
SP	*Knowing*	**(1)** *"I'm calm, I feel well doing it like this."*	Feeling of knowing that triggers the service with tranquility.
SP	*Difficulty*	**(2)** *"Seriously, guys, I have doubts, I don't know if I ventilate directly or when stop the compression."*	Feeling of difficulty in continuity of care.
D	*Difficulty*	**(3)** *"Actually, I knew that compressing was the priority, but at the time it was difficult to delegate so I ended up getting confused, but it's good to learn".*	Feeling of difficulty in the act of delegating functions, no matter how much they talk about the clarity of the importance of the action.
D	*Confidence*	**(4)** *"We are an agile group, the others haven't even started yet and we're done."*	Feeling of trust in teamwork, if unconscious, it can harm the service.
S3			
Stage	**Subtype**	**Metacognitive event**	**Event description**
D	Difficulty	**(8)** *"The causes you should focus on patients with non-shockable rhythms, they should be protagonists, I had difficulty understanding that".*	Feeling of difficulty in articulating learned contents.

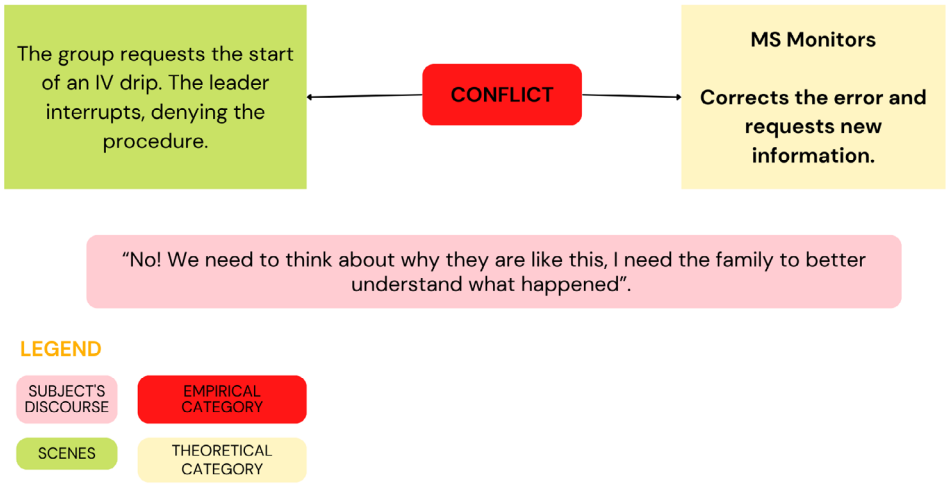
Source: Cordeiro[8].
Legend: *S* - Scenario; *SP* -Simulated Practice; *D* - *Debriefing*; *ME* - Metacognitive experience.

Figure 1. Conflict experienced during the simulation stage of scenario S1 and solution based on an MS.



Source: Cordeiro[8].

Figure 2. Conflict experienced during the simulation stage of the S9 scenario and solution based on a MS.



Source: Cordeiro[8].

Another essential aspect was leadership, which was highly valued in several observed scenarios, standing out for its relationship with metacognition. Metacognitive individuals showed better performance as leaders in the face of the challenges of complex cases.

Two simulation scenarios (S1 and S2), which took place on the same day and with the same group of participants, were observed, which offered us a valuable opportunity to explore the importance of effective leadership in high-pressure environments, such as emergency departments. The lack of assertive leadership in the first scenario (S1) had a significant negative impact on the conduct of the simulated case, converging with the ME of the feeling of difficulty in simulation and debriefing.

The students' speeches during the debriefing (S1) revealed a series of problems associated with inadequate leadership, as shown below:

Excerpts from the field diary - Scenario S1

E1: "I didn't feel she (the leader) listened to me ".

E2: "There were some things missing that should be done because she (the leader) didn't listen to us."

E3: "I believe I was not listened to because she (the leader) was focused on other things that she thought were essential."

In view of these discourses, it is observed that essential tasks for the case solution were not fulfilled due to the leadership ineffectiveness, which resulted in a poor performance of the entire team.

Next, the group felt challenged to improve their performance in the next scenario (S2), so we observed the following discourse in the briefing stage:

Excerpts from the field diary - Scenario S2

E3: "Guys, we fought hard to be able to delegate the functions, let's get it organized, then it's one less thing to think about".

In the previous excerpt, we observed a predictive MS, in which considering the previous poor performance, the group opts for a change in strategy and recognizes that it can be improved. Thus, at the beginning of the simulated practice, a student comments: "*I'm going to be a leader, I feel comfortable with the position, I've already done that".* In fact, their handling of the case was assertive and the performance improved considerably compared to the previous one.

In the debriefing of this scenario, there were comments such as:

Excerpts from the field diary - Scenario S2

E1: "Communication occurred in a more effective and targeted way, it was one of the problems in the last scenario, we agreed on how we were going to communicate".

E2: "I felt capable of performing the function delegated to me".

According to the metacognition bias, observation and awareness of a flawed strategy can help students change and, consequently, impact their performance[20]. Among the main advantages of groups that use effective leadership is the speed of problem solving[21-22]. In this wake, we observed a discourse about such an impact: "*Wow, in this one we were very fast, we improved a lot, we knew the steps".* This is a reflection of good leadership in teamwork and that manifests through a metacognitive experience of feeling of trust, in which there is recognition and awareness of evolution after the end of the task.

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This noticeable change also occurred due to the MK of the strategy type, in which the students evoked their previous experiences to modify items that were then flawed, as observed in: "*I believe that as we had already delimited functions and did not go through the same difficulties as the first time, it was a good strategy*". The awareness of their actions was demonstrated in the debriefing.

DISCUSSION

It is observed the incidence of less than 1% of metacognitive events in the briefing stage. The literature shows few studies focused on the briefing *stage*[23-24], which seems to be justified by the results of this study, because throughout the sixteen scenarios the students had little space to speak and the teacher was the protagonist.

However, one must be careful not to naturalize this. As we observed in the scenarios, during the briefing the teacher starred in the events. It is important to recognize the importance, and perhaps preponderance, of the teacher during this simulation stage; however, this does not necessarily have to occur all the time. Could there be a situation with greater student participation? Page-Cutara[25] points out the need to create standardized models that help in student embracement and allow their autonomous action at this stage.

Regarding the debriefing stage, there was a prevalence of metacognitive events only in scenarios S5 (5 in the simulation and 20 in the debriefing), S6 (3 in the simulation and 5 in the debriefing), S7 (6 in the simulation and 8 in the debriefing) and C13 (9 in the simulation and 10 in the debriefing) scenarios.

The literature is rich in debriefing models[5-9-25]. Its use should be encouraged, as long as it is aligned with the learning objectives. However, it is observed that these models privilege the cognitive field, that is, there are no models that contemplate a metacognitive debriefing[8].

This has direct implications for inattention to metacognitive events that occur during this phase. Therefore, there is a risk that this stage will not achieve its main objective, which consists of reflecting on the action and the subsequent transformation of the student's learning[9-26].

We believe that the main reason for the lack of adoption of standardized models is related to a lack of planning. Teachers devote much of their time to the planning of the simulated practice, while briefing and debriefing are neglected. It is clear that the scarcity of time, multiple tasks, and the difficulty in finding more practical approaches can also contribute significantly to this situation[27].

The reader may wonder: Why is it an advantage to incorporate metacognition into simulation? And here we affirm that the student who limits themselves to the cognitive aspect can restrict their learning to the specific situation experienced during the clinical simulation. In contrast, the one who integrates metacognition into his process is able to adapt the obtained knowledge to other situations that may arise. They are able to articulate and access their prior knowledge when necessary and can employ problem-solving strategies and deal more effectively with the emotions involved, as they are aware of their capacity[8].

In medical education, it is common to report student overload due to the amount of content worked simultaneously[28]. For example, the course in which this study was conducted has a total workload of 9,300 hours, with full-time classes over six years, similar to the structure of other medical courses in Brazil. This extensive workload reflects the complexity of medical training, where students need to integrate a large amount of theoretical and practical knowledge to deal with the dynamics of care.

The "coming and going" is a striking characteristic in medical care, especially in emergency departments. This scenario requires professionals to continuously reassess patients after the initial measures, to identify whether there has been an improvement or worsening of the clinical condition. This practice is essential for patient safety, since clinical evolution may require quick and precise adjustments in the adopted conducts[29].

In emergencies, checking for differential diagnoses is a critical step in increasing the likelihood of a correct diagnosis. This directly impacts the assertiveness of the conducts and the effective resolution of the presented problems. Considering all possibilities is essential to prevent negligence and ensure adequate and effective treatment. In this context, careful analysis of symptoms, structured and targeted physical examination, and complementary tests (if necessary) become indispensable for an accurate and reliable diagnosis[30].

However, even with structured clinical reasoning, errors can occur. A study conducted by Peixoto *et al.*[20] demonstrated that these failures could result from both a deficiency of prior knowledge and a bias in reasoning. It is in this scenario that metacognition presents itself as an essential tool, helping medical professionals to reflect on their own thought process, correcting biases and improving decision-making in complex cases. Thus, the development of metacognitive skills during medical training can be decisive for safe and efficient clinical practice.

In this sense, the more metacognitive student has a greater capacity to transfer knowledge from one situation to another. Therefore, they will be able to take more assertive actions in simulation scenarios and, in the future, in care practice. Moreover, the articulation between previous knowledge and

frequent exposure to new content reinforces the need to use strategies to consciously locate information, which makes metacognition a relevant tool in health education[31].

The MK can be requested in conflict resolution when this knowledge is stored in memory and the person is aware that they need to access it. When a student chooses to share their knowledge, they generate a movement in which the other mobilizes, seeking ways to contribute to the resolution of that problem[8].

Once the learning objectives are understood and previous knowledge is recovered, a strategy for the solution must be established so that the apprentice can continue, which requires MS[8-20].

The increase in the frequency of MS is due to conflicts during simulation scenarios. These issues will also be common in future clinical practice, so the greater use of MS is directly linked to one of the major current health concerns, patient safety[32].

When the apprentice monitors the source of information, observing weaknesses, they promote patient safety. When planning actions, the how, when and why of acting in a certain way, the focus is kept on the main goal, the patient.

And still in this sense, the prediction of difficulties can help in directing which tasks are possible and which need more time, improvement, or even the help of classmates.

If there is awareness of the feelings of difficulty experienced throughout the scenario, the student will have an easier time in their studies, for example: categorizing their weaknesses, offering a tip to reserve more study time on a certain topic and this promotes action focused on weaknesses.

The figure of the leader, on the other hand, by exposing their mental model of thought, can help the group to visualize their decision-making, choose priorities and recognize the presence of cognitive errors, given that the group visualizes the step-by-step of the service.

This demonstrates that leadership not only affects communication, but also performance, which directly reflects on patient care, especially in stressful situations[8]. In this sense, metacognition can help students achieve situational awareness, deeply recognizing their weaknesses and sharing their thoughts so they can be modified according to the needs of the scenario[8-21].

There is a set of actions that favor the development of metacognition and leadership skills: a) the regular practice of self-reflection; b) an active search for feedback, which can be provided in the debriefing stage in simulation, enabling learning from past mistakes and successes; and finally, c) remaining open to new perspectives and approaches. The ability to think about one's own thinking is a valuable tool for leaders who want to be effective, fluent, and oriented towards the development of their teams and organizations.

CONCLUSION

Clinical simulation is an important learning strategy for the teaching of medical practice and in this study, it emerged as a support for the manifestation of metacognition and in the construction of learning to learn, from the subjects' individual and collective perspective. This reinforces the need to apply active teaching and learning techniques and methodologies that engage students, improving their skills and making them more autonomous and secure in their future clinical practice. Furthermore, it is essential to have the support of institutions which must invest in carefully designed curricula.

At the same time, it is essential to focus on empowering teachers by providing them with the skills necessary for an in-depth understanding of crucial aspects of learning, such as the expression of metacognition.

This study contributes to fill the gap in describing and measuring the presence of metacognition during the three stages of clinical simulation. Moreover, it analyzes how metacognitive events are influenced by external factors that promote the explicit manifestation of metacognition, especially through the participants' discourse. Specifically, the study highlights the central role of conflicts and leadership in the metacognitive dynamics, pointing out how these factors shape interactions and the development of metacognitive competencies in the context of simulation.

This study has limitations because it is the analysis of only one group of students, one institution and only two curricular units, reinforcing the need for new studies observing students from the perspective of evolution during their training and new contexts.

Metacognition acts as a transforming agent of learning and should be explored in different contexts by students, teachers and professionals, aiming at improving the quality and safety of patient care.

AUTHOR CONTRIBUTIONS

Thais Lazaroto Roberto Cordeiro contributed to the study concept, data curation, formal analysis, investigation, methodology, visualization and writing - review and editing of the manuscript. Luciana Rocha dos Santos did the formal analysis, visualization and writing - review and editing of the manuscript. Mauricio Abreu Pinto Peixoto contributed with the study concept, supervision and writing - review and editing of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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DATA AVAILABILITY

Research data is available in the body of the document.

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