



## ORIGINAL ARTICLE

# Perception of medical students on the use of Case-Based Collaborative Learning (CBCL) in the human physiology course



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## KEYWORDS:

Active learning;  
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## Abstract

**Introduction:** Medical schools focus on a traditional curriculum in which the student is not the center of the process. This has led to the emergence of active methodologies such as Case-Based Collaborative Learning (CBCL).

**Aim:** The aim of this study was to clarify medical students' perceptions of the use of the CBCL active methodology in the Human Physiology course.

**Material and methods:** This was a qualitative study carried out with 20 medical students studying physiology at a medical school. The students carried out a preliminary study with the material provided by the teacher. In the classroom, they formed small groups and the teacher opened a clinical case on the topic of the lesson and the CBCL session began to discuss it. The whole process was mediated by the teacher. The content analysis proposed by Bardin was used to analyze the information.

**Results:** As a result, it was possible to understand that medical students perceive that active methodologies favor the integration of knowledge, that they are student-centered and that they are a positive experience. Compared to other methodologies, students report better performance and participation, and highlight the difficulty of concentrating when using traditional methodologies.

**Conclusion:** They also point out that the methodology allows for constructive debate, contributing to the development of teamwork and therefore to greater student learning, which are the advantages related to the CBCL's active methodology according to the students. As disadvantages, they highlighted the fear of overload and the lack of commitment of some students.

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**PALABRAS CLAVE:**  
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## Percepción de los estudiantes de medicina sobre el uso del aprendizaje colaborativo basado en casos (CBCL) en el curso de fisiología humana

### Resumen

**Introducción:** Las facultades de medicina se centran en un plan de estudios tradicional en el que el estudiante no es el centro del proceso. Esto ha llevado a la aparición de metodologías activas como el Aprendizaje Colaborativo Basado en Casos (CBCL).

**Objetivo:** El objetivo de este estudio fue clarificar las percepciones de los estudiantes de medicina sobre el uso de la metodología activa CBCL en el curso de Fisiología Humana.

**Material y métodos:** Se trata de un estudio cualitativo llevado a cabo con 20 estudiantes de fisiología en una facultad de medicina. Los alumnos realizaron un estudio previo con el material proporcionado por el profesor. En el aula, formaban pequeños grupos y el profesor abría un caso clínico sobre el tema de la lección y se iniciaba la sesión de CBCL para discutirlo. Todo el proceso estuvo mediado por el profesor. Para analizar la información se utilizó el análisis de contenido propuesto por Bardin.

**Resultados:** Como resultado, se pudo entender que los estudiantes de medicina perciben que las metodologías activas favorecen la integración de conocimientos, que están centradas en el estudiante y que son una experiencia positiva. En comparación con otras metodologías, los estudiantes señalan un mejor rendimiento y participación, y destacan la dificultad de concentración cuando se utilizan metodologías tradicionales.

**Conclusión:** También señalan que la metodología permite el debate constructivo, contribuyendo al desarrollo del trabajo en equipo y por tanto a un mayor aprendizaje del alumno, que son las ventajas relacionadas con la metodología activa del CBCL según los alumnos. Como desventajas, destacaron el miedo a la sobrecarga y la falta de compromiso de algunos alumnos.

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## Introduction

The predominant teaching–learning model in medical schools is centered on a traditional curriculum, in which the student is not the center of the process. It does not promote the efficient development of important characteristics such as critical, investigative, and creative reasoning, nor the role of the student as a protagonist in the process, as it comes from a perspective supported by the Flexnerian report.<sup>1</sup>

As a revolutionary proposal to the Flexnerian teaching model, active teaching–learning methodologies emerge seeking to stimulate students' capabilities, such as autonomy and development of critical thinking, deficient in the traditional model. Since access to information has become increasingly easier, the sense of maintaining a teacher-centered educational process is becoming less and less present, even leading to impasses related to the determination of Active Teaching Methodologies to be adopted in the classroom, as there is a variety of these, such as Problem-Based Learning (PBL), Team-Based Learning (TBL), and Case-Based Collaborative Learning (CBCL).<sup>2</sup>

The active teaching methodology called CBCL was developed at Harvard Medical School, USA, as a process similar to the flipped classroom which is based on the

discussion of cases in small groups, seeking active student participation in their teaching–learning process.<sup>3</sup> Thus, the objective of this study was to clarify the perception of medical students about the use of the CBCL active methodology in the Human Physiology course.

## Materials and methods

### Study design

The present study consisted of descriptive research with a qualitative approach. It was carried out with students who were studying physiology and experienced a module of the course in the CBCL format and who agreed to answer the research questions.

Twenty first-year medical students who were studying Human Physiology took part in the study. The topic chosen for the CBCL session was the cardiac cycle, covered in cardiovascular physiology. The students carried out a preliminary study with the material provided by the teacher and after the previous study, a multiple-choice assessment was carried out using Google Forms®, which is part of the stages of the CBCL applied methodology. In the classroom, students were divided into small groups the teacher presented a clinical case on the class topic. The case was

answered individually, then the individual answers were discussed in the small group and then a consensus was reached among the class. Individual responses were discussed in the small group, so that a consensus was established. The students who participated in the CBCL were contacted in advance and invited to participate in the research.

### Data collection and ethical information

The instrument used to collect information in this study contained identification data such as pseudonym, sex, age, education, occupation, family purchasing power, and 3 open questions in accordance with the objective of the research. The research was carried out following the ethical aspects of the Guidelines and Regulatory Standards for research involving human beings, set out in Resolution No. 466/12 and 510/16 of the Brazilian Health Council (CNS), being approved through Opinion No. 5.291.728 of the Ethics Committee endorsed. This number of interviews was the result of discussion among researchers, when by consensus and following the precepts of Glaser and Strauss they selected theoretical saturation. The interviews were carried out over a period of 3 months and there was no need to repeat any of them.<sup>4</sup>

The answers were collected from 20 first-year medical students at a university in Brazil who were studying human physiology. The average age was 23, and the sample consisted of 14 women and 6 men. The medical course was their first academic training, so they had no academic knowledge of the subject. The students signed a consent form and the interviews were not named, only identified with the letter E (E1, E2, E3...) for confidentiality purposes.

The guiding questions asked to participants through 3 open questions were: (1) From a methodological point of view, what is your perception of the use of active teaching–learning methodologies? (2) Draw a parallel with the 2 teaching methodologies used to teach physiology: Dialogued expository class and CBCL. (3) In your opinion, what are the advantages and disadvantages of using CBCL in the teaching of physiology?

### Data analysis

To analyze the information, the content analysis proposed by Bardin was used, which is organized into different phases. There are 3 stages, starting with the pre-analysis, the exploration of the material and, finally, the treatment of the results, which consists of the inference and interpretation of the information collected, that is, its contents. Pre-analysis involves organizing the collected material, making it operational, which allows the systematization of initial ideas. This organization becomes possible through thorough reading, the selection of content to be analyzed, the formulation of hypotheses and objectives, and the referencing of indices and development of indicators.<sup>5</sup>

In the first phase, the 20 interviews were transcribed in full, concomitantly with the reading that was carried out, which already allowed the detection of contents and indicators and their connections, either with the question

that guided the work or with the other content. A categorization was already being outlined at this stage, but re-elaborated at the end. In the second phase—exploration of the material—categories are defined, after coding and identification of recording units, which correspond to what is intended to be considered as the base unit of categorization. This phase concerns the treatment of the collected material (content), guided by hypotheses and theoretical references. In this phase, the units of context and meaning were recovered, which allowed information recategorization, which already began in the first stage, as it involves the simplification of information that is being systematized, for the purpose of organizing it.<sup>5</sup>

The third stage consists of results processing, inference, and interpretation. At this stage, information for analysis stands out, where inferences can be made, such as intuition and reflective and critical analysis. It is at this phase that meaning is given to the research results. At this phase, themes related to the information obtained were developed and correlated with articles in the area of Medical Education, thus corroborating the results obtained, which allowed a deeper discussion. Thus, in Bardin's criteria, coding and categorization are highlighted, as they facilitate interpretations and inference.<sup>5</sup>

### Results

Twenty students participated in this study, all from the first year of the undergraduate medical course. After exhaustively reading the information obtained in the interviews, context units and meaning units were developed. The context units are related to the questions asked in the interview, and the meaning units are related to the students' responses. Table 1 below systematizes the units that were extracted from the research.

Study participants are identified by the letter "E" for interviewee ("entrevistado", in Portuguese) followed by a number from 1 to 20 randomly sequenced according to the question that was discussed during the interview (Example: E1).

About the use of active teaching–learning methodologies students contextualized that they stimulate the integration of knowledge.

[...] we have a more critical look, we try to have a look as a whole, not just focusing on an issue in itself, on a content in itself but on the state [...] (E1)

[...] I think it helps us to be able to create clinical reasoning, because I think we would only have it later, because I think we learn very separate concepts sometimes and with this type of methodology we can put it together and put it into practice [...] (E8)

Regarding the use of active teaching–learning methodologies students also pointed out that they promote positive experience with the methodology.

[...] I really liked the experience I had, I found it very useful and I think the interaction with colleagues is really cool, so I really enjoyed the experience [...] (E5)

**Table 1** Context and meaning units.

Context units	Meaning units
1- Use of active teaching–learning methodologies	1a- Stimulates the integration of knowledge; 1b- Positive experience with the methodology; 1c- Student-centered methodology.
2- Comparison with other teaching–learning methodologies used in Physiology	2a- Greater use of active methodologies; 2b- Major participation of student in active methodologies; 2c- CBCL promotes greater clinical reasoning; 2d- Difficulty concentrating with traditional methodology.
3- Advantages and disadvantages of CBCL	3a- Allows constructive debate; 3b- Allows the development of teamwork; 3c- Greater learning 3d- May represent an overload; 3e- Lack of student engagement.

Sample size: 20 students. Source: Authors (2022).

[...] expose our thoughts, you know, in front of the group, sometimes what we study is not always what the other studies, so we end up sharing the information [...] (E11)

[...] I think the active methodology is much more participatory, dynamic and has a greater tendency to maintain your interest in the same subject for a certain time [...] (E12)

In the third unit of meaning, related to use of active teaching–learning methodologies, medical students show that the methodology is student-centered.

[...] takes the student a little out of that comfort zone of taking material that is already targeted and a little limited in terms of scope of the subject, in what I have already had contact with active methodologies, the student is forced to go a little further and already be able to start creating situations himself [...] (E18)

[...] author of our own knowledge, it is a way of putting into practice what we studied and it is a way for us to be responsible for our study [...] (E19)

As for comparison with other teaching–learning methodologies used in Physiology, students contextualized that CBCL provides better performance with the active methodologies.

[...] when a clinical case came, something that we discussed and applied, it expanded my knowledge further, there was something that helped me a lot in my understanding of the subject, it is certainly something I will never forget. [...] (E6)

[...] the CBCL method, when you stop for a while to see what will be studied in the next class, I think that the brain is already more prepared, I think that later when you start studying it is more productive [...] (E17)

As for comparison with other teaching–learning methodologies used in Physiology, students contextualized that

CBCL provides more participation with the active methodologies.

[...] so it was cool from the point of view that I made an effort to pursue knowledge [...] (E10)

[...] I think the traditional one is more comfortable, because the teacher arrives with all the subject spoon-fed and gives everything and with CBCL we have to look for first, study first [...] (E15)

As for comparison with other teaching–learning methodologies used in Physiology, students contextualized that CBCL provides better clinical reasoning.

[...] and the CBCL allows you to have a case like this, a more clinical thinking about what we study in theory [...] (E11)

[...] I found CBCL more interesting because it brings all the content that I mentioned more to experience, the clinical aspect, the practical part, it would be like an expansion of the theoretical part to the practical part [...] (E18)

As for comparison with other teaching–learning methodologies used in Physiology, students contextualized the difficulty of concentration with the traditional methodology.

[...] in the lecture class, my biggest difficulty is that sometimes I am a very anxious person, and sometimes I can't sit there paying attention [...] (E7)

[...] the traditional methodology, when we do it, we just sit and listen to the subject and sometimes we are not listening, we end up getting distracted [...] (E12)

As to advantages and disadvantages of CBCL, students contextualized that it allows constructive debate.

[...] because in the debate, in addition to working on knowledge of the subject, you will work on things about yourself, which is the power of persuasion. [...] (E3)

[...] being able to interact in a group, sometimes discussing a thought, a position that you have on a certain subject with another colleague and there we can share knowledge. [...] (E13)

As to advantages and disadvantages of CBCL, students contextualized that it allows the development of teamwork.

[...] the advantage is that I think it is one student being able to help the other to learn the subject, teaching, you know, one student teaching the other to learn the subject, it also helps students to work more as a team and ends up bringing students closer together. [...] (E14)

[...] the advantages, as I said, are for students to be the authors of their own learning and share it with friends. [...] (E19)

As to advantages and disadvantages of CBCL, students contextualized that it establishes greater learning.

[...] it makes us better able to perceive the content in a different dimension than merely learning by heart, memorizing expressions, memorizing processes. [...] (E4)

[...] the course of physiology is literally the construction of a reasoning about how the human body works, this way of studying is much better than us sitting down and memorizing. [...] (E10)

As to advantages and disadvantages of CBCL, students contextualized that it can represent an overload.

[...] it's not always possible to reconcile this within Medicine, sometimes we have to study many other things and then sometimes I don't have time to focus on what I would need, take Guyton that is here by my side and study the whole chapter. [...] (E7)

[...] the time for us to prepare for class, sometimes it's complicated, because we have a lot of things to do, so it's difficult for you to prepare to get there [...] (E9)

As to advantages and disadvantages of CBCL, students contextualized that it can be unproductive due to the lack of student engagement.

[...] not everyone always studies, as it is in a group there will always be someone who rides on the other's coattails. [...] (E11)

[...] because it was a random group, perhaps the people I made the group with were not as engaged in the subject [...] (E19)

## Discussion

Learning is a socio-historical and cultural process that occurs from the interaction between the individual and the social environment in which they are inserted. This way, active teaching–learning methodologies allow the construction of knowledge in a collaborative way, encouraging the exchange of experiences among students and dialogue among them. Finally, we can mention the constructivist approach that highlights the importance of the student's active role in the

construction of their own knowledge. Through active teaching–learning methodologies, they are challenged to develop hypotheses, test them, and refute them, thus developing important cognitive abilities such as creativity, reflection, and problem-solving.<sup>6</sup>

In medical education, learning activities are often based on patient cases—real patients (on the wards, in clinics, and in the community), simulated (people acting as patients with specific problems) cases, virtual (online patients of varying degrees of authenticity and sophistication) cases. It is believed that such cases increase the relevance of the subject by focusing on the real lives and real performance of healthcare professionals. Basic, social, and clinical sciences are studied in relation to the case, are integrated with clinical presentations and conditions (including health and illness), and student learning is therefore linked to real-life situations.<sup>7</sup>

The use of active teaching–learning methodologies has been widely discussed in recent years by several international authors, who highlight the importance of a student-centered approach, rather than a teacher-centered approach. According to Prince's study, traditional teaching methods, based on lectures, are not effective in training professionals to be capable of dealing with the challenges of today's world. In this study, the authors argue that active methodologies, which encourage students' active participation in the learning process, are essential for the development of skills such as critical thinking, problem-solving, and collaboration. The importance of active and collaborative learning in the development of socio-emotional skills such as empathy, resilience, and the ability to work as a team should also be highlighted. Active methodologies are essential not only for the acquisition of knowledge, but also for the formation of conscious and engaged citizens.<sup>9</sup>

A study carried out in 2020 investigated students' perception regarding the use of active methodologies. The authors concluded that they positively evaluated the use of these methodologies, indicating that they provided a more meaningful and enriching learning experience. This dimension of student learning related to positive experience is linked to the results of their learning. Students demonstrated a strong interest in active learning sustained due to high levels of discussion, promoting the development of efficient learning gains. In short, the use of active methodologies has been widely discussed by international and current authors, who highlight the benefits of these methodologies in promoting more meaningful and engaging learning.<sup>8</sup>

Compared to other more traditional approaches, such as lectures, students consider that CBCL favors more autonomous and meaningful learning, which encourages the development of skills such as creativity, curiosity, and the ability to solve problems. Furthermore, they highlight that this method encourages collaboration among students, promoting an exchange of experiences and knowledge relevant to group learning. In summary, CBCL is seen by students as an innovative and effective methodology for teaching Physiology, which favors meaningful learning and students' ability to apply the concepts studied in practical and everyday situations, providing greater enjoyment and integration.<sup>10</sup>



A study in Boston compared learning in Human Physiology using the CBCL with PBL. The results showed that the CBCL was more efficient in increasing the understanding of concepts by students who had a lower performance in the PBL methodology, in addition to contributing to the development of research and critical-thinking skills. One of the relevant points is that students participate more actively in groups of 4 components as recommended by the CBCL, besides the preparation that must be carried out with the availability of materials for prior study.<sup>10</sup>

Another study, conducted at the University of Michigan, in the United States, also compared the use of CBCL with PBL and traditional classroom teaching. The results revealed that the CBCL provided greater student engagement with the subject content, in addition to encouraging active participation and critical reflection on the concepts covered.<sup>11</sup>

Recent studies have demonstrated that CBCL can effectively improve clinical reasoning skills in medical education. The approach allows students to share their perspectives and knowledge, ask clarifying questions, and receive feedback from peers and educators. This collaborative process helps students develop critical-thinking and problem-solving skills, which are essential in making effective clinical decisions. Additionally, CBCL helps develop effective communication and teamwork skills, which are crucial in the healthcare profession. Students can learn to work effectively together with their peers and other healthcare professionals, creating a culture of collaboration and improving patient outcomes. This approach has been shown to improve engagement and active participation, providing a more innovative and flexible learning experience. CBCL and clinical reasoning continue to be important areas of study in medical education. The collaborative approach provides an effective way to improve clinical reasoning and communication skills. As medical education continues to evolve, it is essential to adopt these approaches to train the next generation of healthcare professionals.<sup>12</sup>

In contrast, in traditional classroom methodology, emphasis is placed primarily on the transmission of information, with few opportunities for debate and discussion about the application and relevance of learned concepts. Furthermore, other teaching-learning methodologies, such as PBL and project-based learning, have also been used in Physiology with positive results. These approaches emphasize the active and collaborative participation of students in solving problems or carrying out practical projects, encouraging the application of theoretical concepts learned in real situations. However, regardless of the methodology used, difficulty concentrating is a common challenge faced by students and this difficulty is due to numerous factors, such as: the inability to master certain topics, fear of failure, and frustration at not being able to achieve the expected objectives. Therefore, it is important that teachers are aware of this problem and adopt appropriate pedagogical strategies to help students maintain focus and motivation during classes and study activities.<sup>13</sup>

Constructive debate is a technique that aims to promote discussion and critical questioning of topics and ideas. In this process, participants show their points of view in a

respectful and constructive way, seeking to identify flaws, and find solutions to complex problems. This type of debate is essential to foster collaborative learning, as it allows each participant to present their perspective and contribute to the collective construction of knowledge.<sup>14</sup>

Collaborative learning provides constructive debate and has been widely used as effective strategies to facilitate the understanding of complex concepts and promote the development of critical skills in university students. Collaborative learning refers to a process in which students work together to achieve a common goal, using their skills, knowledge, and experiences to solve problems and create solutions. This process involves active discussions and the exchange of ideas and perspectives, leading to the collective construction of knowledge. In general, collaborative learning and constructive debate are highly effective teaching strategies that engage students in the active construction of knowledge and encourage the exchange of ideas and perspectives. When applied to the discussion of scientific articles, these strategies can deepen students' understanding and promote the development of critical skills that are essential for professional training and career success.<sup>15</sup>

Collaborative learning and teamwork are fundamental concepts for the success of projects in different areas. These practices are increasingly valued in the job market, as they allow individuals to work together more effectively, using their strengths, and making up for their weaknesses. Collaborative learning is a practice that is based on the idea that people learn best when they work together and share knowledge. The author highlights that this form of learning can be applied in different areas, such as education, health, and business, and offers benefits such as motivation for those involved, better retention of the content learned, and greater problem-solving.<sup>16</sup>

Collaborative learning is a teaching approach in which students work together to achieve a common goal. This involves the exchange of knowledge, skills, and experiences among group members. This approach has been shown to be effective in improving student learning and developing social skills. It has been observed that collaborative learning can lead to greater student learning.<sup>10</sup>

Furthermore, collaborative learning can improve students' performance in written assignments, where it was observed that those who worked in groups had a better understanding of the subject and produced higher quality work than those who worked alone. Additionally, collaborative learning can help students develop social skills, such as communication and problem-solving as a team. It is also observed that collaborative learning can be a tool to help students develop important skills and help them become more efficient professionals.<sup>17</sup>

Active methodologies are a teaching approach that places students as the protagonists of their own learning. They are characterized by the use of pedagogical resources such as group discussions, problem-solving, case studies, projects, among others. However, the use of active methodologies can create a study overload for students, especially when there is no adequate planning of activities and the time available to carry them out. A study carried out by Lopes et al. (2016) evaluated students' perception regarding the use of active methodologies and it was observed that the majority

considered that the proposed activities required more study time than expected and that the theoretical course workload was insufficient to absorb all the content.<sup>18</sup>

Another study that analyzed the relationship between the use of active methodologies and study overload observed that the practice of group activities and classroom discussions were those that generated the most work overload for students. To avoid study overload, teachers need to properly plan activities and consider the time needed to carry them out. Furthermore, it is important that students are guided on how to manage their study time and organize their activities efficiently.<sup>19</sup>

Student engagement refers to students being actively involved in their learning tasks and is divided into behavioral (students' levels of participation in their learning tasks), cognitive (the cognitive and self-regulation strategies used by students in their learning processes), and emotional engagement (students' emotional reactions to teachers, students, learning, and school in general).<sup>20</sup> It also showed that there is a moderately strong and positive correlation between student involvement and academic results, which was stronger for behavioral involvement. Most known methodologies advocate that groups be divided and organized randomly, and therefore heterogeneously. This encourages students to develop attitudinal skills, exercising interpersonal and interprofessional relationships, corroborating the students' responses that they find it difficult to interact with the group, which is an important factor for low engagement.

Collaborative learning allows the training of essential skills for clinicians (e.g., exploration, self-learning, application of knowledge), but has the potential to overwhelm students and distort their ability to work on problems, impairing their memory, and knowledge acquisition. The disadvantages can be compounded when limited time is given to work on an unfamiliar specialty.<sup>21</sup> Therefore, the teacher's organization of these moments in advance, sending out the material, is fundamental to avoiding these situations, and organizing the time during the meetings is important for carrying out the activities in a way that doesn't lead to frustration or low student engagement.

It is important to highlight that active methodologies are diverse and range from project-based learning, cooperative learning, PBL, and others. What the studies have in common is that they evaluated the impact of these practices on student engagement and motivation. A study evaluated student motivation in a university course that used active learning methodologies and the results showed that students were more motivated than those who took a traditional course. The authors suggested that the opportunity to work on projects relevant to their areas of interest contributes to student motivation.<sup>22</sup>

The study met expectations based on understanding student performance when conducting a class using the CBCL methodology. The initial difficulties presented were mitigated as the activity was carried out, providing the tutor with verbal and visual feedback of adequate student acceptance. Subjectively, it was possible to observe that the students' performance represented an absolutely dynamic and engaging process in which the vast majority were involved in a very eloquent and engaged way. The

constructive interventions promoted brought students greater confidence and enthusiasm in conducting the proposed case, as well as its discussion through small groups that shared their answers, providing a safe and motivating environment for the student. The CBCL methodology has been shown to stimulate the integration of knowledge, bringing students a positive experience, through this active, student-centered methodology with the promotion of clinical reasoning.

## Ethical considerations

The study was not carried out with patients or in a hospital environment. An anonymous questionnaire was used.

## Declaration of competing interest

We declare that there are no conflicts of interest between the authors.

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