

Perception of medical students on the development of the clinical reasoning competence

Percepção sobre o desenvolvimento da competência "raciocínio clínico" por graduandos de curso de medicina

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ABSTRACT

Introduction: The way by which physicians process clinical reasoning is a relevant topic in the discussions on medical education because, in medical activity, the ultimate goal is to obtain the correct diagnosis and conduct. The challenge is to highlight which factors influence this performance.

Objective: The objective of this study is to understand how the development of the clinical reasoning competence occurs according to the medical students' perception.

Method: This research has a descriptive focus and employs a qualitative approach in the ordering of data, classification process, and final analysis of information from 36 semi-structured interviews with medical students, from July to September 2020, in Curitiba, Paraná, Brazil.

Result: Thematic analysis was carried out, and the category 'perception of the factors that influence its achievement' emerged, with the 'methodological and curricular structure' subcategories perceived as the main influencing factors, through characteristics such as interdisciplinarity, early interaction with practical activities, stimulus to autonomy and teaching guidance. Participation in monitoring, academic leagues and extension projects were also considered, as well as the experience of the process of learning appropriation.

Conclusion: The present study addresses the topic of clinical reasoning and brings as a contribution the analysis of the factors that influence its development, during undergraduate school, based on the students' viewpoint. Its results bring benefits to medical education, as they expand the understanding of the process of developing the clinical reasoning competence.

Keywords: clinical diagnosis; clinical decision-making; medical students; medical education; qualitative research.

RESUMO

Introdução: A forma como os médicos elaboram o raciocínio clínico é um tema relevante nas discussões sobre ensino médico pois, na atividade profissional, o objetivo final é obter diagnóstico e conduta corretos. O desafio está em evidenciar quais fatores influenciam no desempenho dessa competência.

Objetivo: Esta pesquisa buscou compreender como o desenvolvimento da competência raciocínio clínico ocorre na percepção de estudantes de Medicina.

Método: Com enfoque descritivo e abordagem qualitativa, procedeu-se a ordenação dos dados, classificação e análise final das informações oriundas de 36 entrevistas semiestruturadas com estudantes de graduação em Medicina, entre julho e setembro de 2020, em Curitiba, PR, Brasil.

Resultado: Após análise temática, obteve-se a categoria percepção dos fatores que influenciam na aquisição do raciocínio clínico, com as subcategorias estrutura metodológica e curricular percebidos como os principais fatores influenciadores, através de características como interdisciplinaridade, interação precoce com atividades práticas, estímulo a autonomia e orientação docente. Participação em monitorias, ligas acadêmicas e projetos de extensão também foram valorizados, assim como a experiência do processo de apropriação desse aprendizado.

Conclusão: A presente pesquisa aborda o tema raciocínio clínico e traz como contribuição a análise dos fatores influenciadores no seu desenvolvimento, durante a graduação, na visão dos estudantes. Seus resultados trazem benefícios para a educação médica, pois ampliam a compreensão do processo de desenvolvimento da competência raciocínio clínico.

Palavras-chave: diagnóstico clínico; tomada de decisão clínica; estudantes de medicina; educação médica; pesquisa qualitativa.

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INTRODUCTION

A major debate in the field of health sciences education is what model best describes how physicians make diagnostic decisions. Clinical teachers face the daily challenge of helping their medical students to become competent diagnosticians. The process of thought elaboration and decision-making associated with diagnostic reasoning is a central issue in clinical practice and probably the most important goal of medical education¹. The construction of clinical reasoning is related to the management and storage of information necessary to conduct a clinical history investigation². The challenge lies in identifying which factors influence professional performance in this task³.

The concept of clinical reasoning is not yet clearly defined in the literature and has been used as a synonym for clinical thinking, clinical problem solving, decision-making, and clinical judgment. Clinical reasoning is the result of data interpretation by a medical professional facing a specific situation, in relation to a specific patient in a specific context of signs and symptoms; in this situation, they bring their own knowledge, skills, and beliefs, which influence their perception and interpretation of data⁴. Clinical reasoning can also be understood as a process and an outcome. A patient's perspective, the doctor-patient relationship, and the environment where the patient is being cared for must also be considered in this process⁵.

Logic models have been studied to explain how physicians make diagnoses: deduction is when a known and proven rule is applied to a given case to arrive at a definitive result; induction is when the results of many cases are collected to define a probabilistic rule; and abduction, a typical detective mode, is when the physician, facing a result, tests their hypotheses with additional investigation, physical examination, or laboratory tests, and then proposes a previously known hypothesis in which the case may be included. Authors claiming that Bayesian reasoning is a natural part of clinical decision-making defend the probabilistic nature of clinical reasoning. Other authors believe that the clinical doctor generates hypotheses by abduction, followed by repeated cycles of Bayesian reasoning^{6,7}.

Theories from the areas of education, psychology, and skill development have been suggested to improve the understanding of clinical reasoning⁸. Their construction has been presented in two forms, namely, analytical and non-analytical reasoning. The former is for solving complex cases and the latter, for common clinical cases. For non-analytical reasoning, mental schemes or disease scripts are created and stored in the memory, with the purpose of automatically recognizing patterns and making correct diagnoses, which are improved by clinical experience^{9,10}. From knowledge

organization, two modes of thought are established when the process of clinical reasoning is initiated: the fast mode or System 1, which recognizes patterns and generates ideas, and the slow mode or System 2, which is also known as analytical. Both reasoning strategies, that is, non-analytical and analytical, are effective and used simultaneously and interactively^{11,12}.

Most research is about diagnostic process and indicates that there is not a particular reasoning strategy that could be taught to students. It depends on the abundance and good structuring of the illness scripts a physician has gradually stored in memory over the years of education, developed after being exposed to a variety of clinical problems, drawing attention to the importance of the undergraduate teaching model.

Basic sciences should be taught in a clinical context to promote the development of diagnostic reasoning skills during the undergraduate years, because the science knowledge encapsulation process begins as soon as medical students are introduced to real patients, during clinical encounters or case presentations. So, experience with patients is essential for establishing new connections in the memory for developing illness scripts¹³⁻¹⁵.

Despite that, some undergraduate curricula still tend to focus the first half of the medical course on the basic sciences, and then promote clinical experience, with specialty rotations. In addition, interviewing and communication skills related to patient care are often taught separately from those of observation and thinking, generating independent links between these skills.

In recent decades, new emphasis has been given to higher education with the objective of stimulating problem-based learning (PBL), especially in the training of medical professionals who are expected to have a generalist, humanistic profile, focused on comprehensive care, with social responsibility and committed to citizenship. Based on the principle of autonomy and interdisciplinarity, active methodologies such as PBL promote teaching based on investigation and observation of reality, providing articulation between the university, the service and the community. For this, an integrated curriculum proposal is essential¹⁶.

Broadening the understanding of how physicians develop and determine clinical reasoning to reach the correct diagnosis from the students' perspective, in the context of active teaching methodologies, which can bring important information to optimize the teaching-learning process¹⁷. Much of the knowledge in the literature on the development of clinical reasoning during the medical course is related to research that does not include the students' perspective and does not clarify their view on this topic. Therefore, this study intend to understand the perception of medical students on the development of clinical reasoning competence.

Understanding the information processing and the cognitive process favors the understanding of the construction of clinical reasoning, perception, processing, encoding, storage, retrieval and use of information. The greater knowledge about this point of view will allow a better identification of how to optimize the development of this competence and expand teaching-learning strategies to reach different mental processes.

OBJECTIVE

The objective of this study is to understand how the development of clinical reasoning competence occurs from the medical students' perception.

METHODS

The present study is a descriptive research, with a qualitative approach. This is employed to understand and deepen the knowledge on the participants' perception of the natural and relational contexts of the reality that surrounds them, based on their experiences, opinions and meanings; to express their subjectivities; disclose the characteristics of a population; and establish relationships between the variables^{18,19}. According to a descriptive qualitative approach, the instrument for data collection followed the technique of the semi-structured Interview, according to Minayo and, later, the Content Analysis technique, according to Bardin^{20,21}.

The study was approved by the Research Ethics Committee of Pequeno Príncipe School of Medicine, in Curitiba, PR, Brazil, under Certificate of Submission for Ethics Appreciation Number. 26699019.7.0000.5580, with favorable opinions numbers 3.854.020 and 4.124.239.

The study participants were recruited by volunteer adherence, after being informed about the research through communication by their class representatives, in a higher education institution that has an undergraduate medical course in the city of Curitiba, state of Parana, Brazil, with a curriculum proposal based entirely on the active methodology. A total of 38 medical students from all six academic years were interviewed. Of the total participants, two were excluded due to technical problems in recording the interview, because the speeches could not be retrieved, and 36 remained. The sample size was defined based on the saturation of the obtained information.

Data collection followed the semi-structured interview technique and a script was presented to the participants, showing how the interview would be conducted on the topic and the formulated questions based on the association of available scientific information with the actual gaps. The questions asked in the interview were:

- What do you understand by the term clinical reasoning?
- In your opinion, how important is it to develop clinical reasoning in the medical field?

- In your opinion, how does clinical reasoning develop during the undergraduate medical course?
- Are there curricular units in your course (subjects, internships, others) in which you can identify an intention to stimulate the development of clinical reasoning? If yes, can you give examples?
- In your opinion, which factors may be considered more important for developing good clinical reasoning in the undergraduate medical school?
- What do you think about the development of your clinical reasoning at this point in the course?
- How do you think you reached this stage of development?
- What can you do to optimize the development of this competence during the course?
- Can you suggest how the development of this competence could be encouraged within the undergraduate medical education curriculum?
- Would you like to add any comments or information?

The online recording was performed using the Google Meet platform. Subsequently, the thematic content analysis was conducted to identify the core meaning of this communication. The analysis was divided into three stages: pre-analysis, material exploration, and treatment of results, with interpretation. The pre-analysis included the pre-analytical data organization from the transcription of the interviews and their reading; material exploration was carried out through classification of categories and thematic organization, with identification of core meanings; and the treatment of results took place through analysis of information, interpretation of thematic contents, discussion, and theoretical foundation.

From the research question, the study objectives, collection and analysis of information, and answers were obtained on the influencing factors in the acquisition of clinical reasoning competence, which corresponded to a variety of opinions and experiences with meanings at the individual or collective level on the topic. The answers were distributed into thematic units and qualified into categories and subcategories. The categories were previously defined according to the research instrument and had different elements that characterized them, the subcategories. Each subcategory corresponded to a thematic section forming a common whole, the main category. The subcategories were defined according to common characteristics and, within them, units of responses were identified, with better distinction of speeches.

RESULTS

Table 1 shows the participants' characteristics, such as sex, age, and academic year, in their absolute frequencies.

The categories, subcategories and units of responses are depicted in Table 2.

Table 1. Participants' sex, age, and academic year (Absolute frequencies)

Items	Number of participants
<i>Sex</i>	
Female	21
Male	15
<i>Age</i>	
18–20 years	7
21–25 years	26
26–30 years	3
<i>Academic Year</i>	
1 st	6
2 nd	7
3 rd	6
4 th	6
5 th	5
6 th	6

Source: The Author (2021)

Table 2. Categorical classification of the obtained information

Predefined categories	Subcategories	Response units
Identification of the factors that influence clinical reasoning acquisition	Methodological framework	Importance of PBL
		Encouraging student proactivity
		Interdisciplinarity
	Curricular structure	Early interaction with practical activities
		Module structure
		Teacher's role
Appropriation of clinical reasoning learning	Experience process	Connection to tutoring, internships, and academic leagues
		Resources
		Difficulties
		Expectations

Source: The Author (2021)

Category 1: Identification of the factors influencing the acquisition of clinical reasoning

In this category, students observed that the acquisition of clinical reasoning occurs gradually and progressively; they recognized the methodological structure and the curricular model of their course as the main influencing factors in the acquisition of clinical reasoning.

I think that clinical reasoning develops gradually during the undergraduate years. So, I can see its development and as the course becomes more complex, reasoning goes along with it, and we keep improving it, assisted by the teachers who also help us make this transition from basic thinking to practice, and I see this process is gradual, that it keeps improving (S23, 20 years old, 2nd year).

I think PBL is one of the best, one of the best ways for us to build a quick and very effective clinical reasoning (S30, 21 years old, 1st year).

I think we have a curriculum matrix that focuses on clinical reasoning more than on other things, and I think this is very, very positive (S32, 25 years old, 6th year).

The fundamental role of the medical schools, of all the lessons, the tutorials, the practical lessons, all the time they are teaching us to be proactive, and I think that from that moment on, from that contact I had with PBL, I was able to develop much more (S12, 21 years old, 3rd year).

It is precisely this process of integrating the subjects, this integrated curriculum that makes it easier. It gives more stimuli and influences you to relate one subject to another, and after all, it will all be an integrated thing, when we are working as professionals, there won't be separate subjects (S29, 20 years old, 1st year).

In clinical training, since the beginning of the course, you have activities in the health unit, when you start assisting patients, and they develop your ability to obtain the patient's anamnesis and establish a clinical reasoning based on what you collect (S5, 25 years old, 4th year).

These syndromic elements in which we explore the diseases and try to find the differences between them really helped us with reasoning (S22, 23 years old, 6th year).

In PBL, tutors are essential, because they encourage us to develop reasoning, to raise hypotheses, to seek more information about the case (S10, 27 years old, 3rd year).

Taking part in more leagues, more internships that allowed me to have more contact with patients and observe the service routine a little more to develop reasoning a little better (S6, 26 years old, 3rd year).

Category 2: Appropriation of clinical reasoning learning

The students' reports show that the experience of the appropriation of the clinical reasoning learning process during undergraduate medical school corresponds to a trajectory permeated by reflections and feelings, illustrated by resources as confidence in the institution academic guidance and a good understanding of the methodological process; difficulties such as lack of knowledge and content overload; and expectations of professional perfection and assertiveness.

It was around the third semester that I started to learn something, I started to feel more confident to talk to patients. I realized I reached a new level, which I realized from the fifth semester onward. I felt new improvements in the seventh semester. In the ninth, the theoretical part ended, and I thought, well, I really have a good theoretical basis, I know something about

practice, but now that I will be 100% immersed in practice during residency and now what will it be like? I wanted to be, I mean, everyone wants to be a perfect doctor after their residency, but it is impossible (S3, 23 years old, 5th year).

To master the subjects, practice a lot, and train clinical cases are the most difficult parts, I think. I have a lot of difficulties; for example, I get frustrated when a patient with a cough comes to the health unit. I end up thinking of the most prevalent diseases, which are asthma or even a cold, but sometimes I forget other less common causes, for example, a gastrointestinal problem that can also cause coughing. Sometimes, finding these other paths is the most complicated part for me, so far (S4, 25 years old, 5th year).

In the first period, we had a lot of theory, but we already realized that there was an attempt to fit us there into the clinical picture, but due to the lack of knowledge, we got a little lost and still didn't know how to do it, but there was the attempt of the teachers (S17, 21 years old, 2nd year).

I think I still have a lot to learn, but I feel a lot of confidence in what is being proposed to me. So I think that if I'm dedicated enough to follow what's proposed to me, I'll be able to finish college with a lot of reasoning, but at the moment, for example, I don't have the ability to develop a very elaborate reasoning (S18, 21 years, 1st year).

I am very satisfied with what I have developed so far. I think I was well prepared both on my part and the school. It is obvious that there are some gaps in the process, and I believe they will be filled only with future medical practice (S21, 23 years old, 5th year).

So, I understand that there is a lot to improve in my clinical reasoning, but I see that it is something that the university has encouraged since the first period (S24, 20 years, 2nd year).

DISCUSSION

Scientific evidence has shown that the organization of knowledge is essential for building clinical experience. Studies on different teaching approaches in undergraduate medical schools have been conducted, but no consensus was established on how to teach diagnosis and decision-making. Considering the multifaceted trajectory of the development of this competence, it is evident that a better understanding of the determinants involved in the way of thinking, making a diagnosis, and making decisions can increase its promotion and influence the teaching-learning process²²⁻²⁴.

According to the participants' experience and opinion, the main factors influencing the development of this competence during undergraduate school are the methodological and curricular structures of the course and the use of the PBL

methodology is a central axis of their program for the acquisition of diagnostic reasoning. Indeed, active teaching-learning methodologies show characteristics that meet this alignment, promoting teaching based on investigation and observation of reality and expanding the possibility for the students to find solutions and make decisions, which are essential for medical diagnosis. The characteristics of its methodological structure, such as encouragement of student proactivity and interdisciplinarity, identified active methodologies as determinants in the development of diagnostic reasoning^{25,26}.

The PBL methodology guides the medical course curricular structure, promotes the engagement of teachers, student and administrative staff, and demands the integration of subjects. Since the curricular model manages the methodological structure, PBL may have contributed to recent changes in the curricular organization, integrating basic sciences with the clinical environment, with well-defined philosophy and objectives of professional training and collaborative self-learning²⁷.

Traditionally, the structuring of knowledge in the medical school curriculum is divided into two specific domains: biomedical mechanisms, such as anatomy, pathology, and physiology, and clinical encounters for developing the ability to investigate signs and symptoms of diseases. The first half of medical school is usually focused on basic sciences, and the later years on clinical activities. This distinction between basic and clinical knowledge has received much criticism, promoted a debate on the process of how physicians use clinical reasoning, and brought changes to the curricular structure of several medical courses. Some studies in the literature have supported an integrated medical curriculum with connection between basic sciences and clinical experience for the adequate development of clinical reasoning skills in medical students^{14,28}.

Our results reinforce the concept that knowledge about diseases, associated with an early contact with practical situations, connecting basic and clinical sciences, might be helpful to promote cognitive management. Moreover, it shows that the students' active behavior in search of knowledge, enables them to find solutions, develops skills, and creates real involvement in their own training process.

The paradigm shift in medical training toward a model based on integrality and ethical and humanized professional training is directly linked to the early approximation of the student to the practice environment. Contact with clinical situations, which is associated with knowledge about diseases, is essential to promote cognitive management. Thus, early and frequent exposure of students to real cases should be a priority, along with scientific knowledge, because the process of knowledge encapsulation begins as soon as students are

introduced to real patients in clinical encounters²⁹.

According to the National Curriculum Guidelines, the integration of disciplines and content is fundamental to ensure the inseparability of teaching, research and extension, and the understanding of health as an interdisciplinary process, recognized in the students' narratives as important for diagnostic thinking³⁰.

This study also found the curriculum structure as a main point for the development of diagnostic reasoning, based on the longitudinal and sequential organization of content in thematic segments. The change in direction of the curriculum proposal in medical education in recent years, which has now focused on competencies and is based on PBL, brought a context of challenges in the academic training of a new generation of students, with changes in scenarios, educational resources, and assessment modalities. This curricular organization favors a global view of the disease process, facilitating diagnostic recognition, as it promotes the confluence of knowledge, medical skills, and clinical teaching simultaneously.

The present study showed that teachers' participation as learning-process guides was essential for the development of diagnostic reasoning, either as messengers of this profession through their speech or from their behavior and postures, either as knowledge disseminators or by being close to the students. Several approaches have been proposed for teachers to train students to become good problem solvers, with flexibility in reasoning³¹.

It is essential, from an educational perspective, to understand why difficulties in clinical reasoning appear in order to promote appropriate correction, ensuring the effective and safe management of patients, because the overall rate of diagnostic error remains very high, despite the scientific and technological improvement in medicine over the last century. However, critically evaluating the effectiveness of these varied pedagogical actions and their outcomes in academic training requires a broader understanding on how physicians learn to reason in the clinical environment and why reasoning difficulties appear, so that these problems can be solved.

Chamberland et al. (2005) understood that clinical reasoning is not an innate ability but a competence to be developed; they also believed that the role of the teacher is fundamental for the development of this competence, for identifying difficulties, monitoring, conducting, and giving personal, professional, and educational feedback in the context of medical care³². For teachers, ensuring the quality of patient care while promoting students' diagnostic reasoning skills constitute the true art of clinical teaching in medical education³². More recent scientific evidence has shown the need for a more comprehensive approach to clinical teaching,

following the recognition of the benefits of both the analytical and non-analytical approaches to diagnostic reasoning, while respecting students' intellectual needs and level of expertise³³⁻³⁶.

The creation of an informal curriculum, with participation in monitoring, academic leagues, and extension projects was also valued by the interviewed medical students to expand technical knowledge and offer proximity to practice, positively influencing clinical reasoning. This reinforces the need for improvement and development of extracurricular activities that complement academic education. They add skills; promote articulation among teaching, research, and extension; develop an investigative spirit; and promote the dialogue between the academic community and society, forming students who are citizens and humanistic professionals, focused on comprehensive care with social responsibility³⁷.

The experience of learning clinical reasoning during the undergraduate years is presented in this study as a trajectory illustrated by resources, difficulties, expectations, pressures, and frustrations to achieve excellence. From the beginning of the course, students have many hopes, such as the acquisition of knowledge, familiarity with medical practice, and the development of technical and affective skills. The medical students' cognitive and functional mental health impairment may result in worse academic performance, bringing difficulties for the development of competencies required for proper medical training^{38,39}. However, it is not possible to clearly establish inferences on this topic here because it was not the objective of the present study.

STRENGTHS AND LIMITATIONS

A strong point of the study is that it expands the understanding of the development of clinical reasoning competence from the students' perspective rather than the teachers'. The students' perception of the reality was identified through a large amount of information obtained on the subject, bringing a valuable material that described their relationship with the academic context.

The study has some limitations. Since the population defined to participate in the study belongs to a single medical school that follows a specific methodological structure and a particular curricular model, the results may vary in other institutional settings and national contexts. In addition, the analysis included students from all academic years, but the time during which the study was conducted did not allow a longitudinal analysis of the students, throughout their training. Furthermore, the interview was conducted online because of the coronavirus pandemic, preventing the observation of the scenario and a direct contact between the interviewer and interviewee. Only a few studies with the same objective, target

population, and method were found in the literature, limiting the comparison of results.

CONCLUSIONS

According to our results, the methodological structure of the course and its curricular proposal are the main influencing factors in the development of clinical reasoning competence, during medical undergraduate school. The methodological characteristics, such as interdisciplinarity, early interaction with practical activities and encouragement of autonomy are determinants for the development of clinical reasoning skills. The curricular structure, based on the organization of contents in a longitudinal and sequential approach with thematic modules, is crucial for the development of diagnostic reasoning. In this context, the teacher's participation is essential as a learning guide for the development of diagnostic reasoning. The construction of an informal curriculum, with participation in tutoring, academic leagues and extension projects, expands technical knowledge and gets closer to practice, positively influencing clinical reasoning. The appropriation of clinical reasoning learning during undergraduate school is illustrated by resources, difficulties and expectations to achieve excellence, calling attention to the emotional structure and diagnostic performance.

The ultimate goal in medical practice is to obtain the correct diagnosis and establish the appropriate conduct. The development of clinical reasoning competence is essential for this purpose. Helping medical students to become competent diagnosticians is probably the most important goal of medical education. The challenge is to identify which factors influence professional performance for this task. The present research addresses the topic of clinical reasoning and brings as a contribution the analysis of the factors that influence its development during undergraduate school, from the students' point of view. Its results expand the knowledge about the process of diagnostic establishment and construction of clinical reasoning and may optimize the development of this competence in medical education.

AUTHORS' CONTRIBUTIONS

Andressa Miguel Leitão: study author, corresponding author, conceptualization, data curation, formal analysis, investigation, project administration, writing, review, editing. Roberto Zonato Esteves: study author, conceptualization, data curation, formal analysis, investigation, project administration, writing, review, editing.

CONFLICTS OF INTEREST

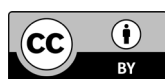
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