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## **Development of Critical and Clinical Thinking in Medical Education: Methods, Strategies, and Practical Approaches**

### **Levchyk Olena Ivanivna**

PhD (Medicine), Assistant Professor of the Department of Therapeutics and Family Medicine, Faculty of Postgraduate Education,  
I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine,  
Ternopil, Ukraine  
E-mail – [levchykoi@tdmu.edu.ua](mailto:levchykoi@tdmu.edu.ua)  
<https://orcid.org/0000-0001-8398-492X>

### **Lazarchuk Tetiana Borysivna**

PhD (Medicine), Associate Professor, Associate Professor of the Department of Therapeutics and Family Medicine, Faculty of Postgraduate Education,  
I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine,  
Ternopil, Ukraine  
E-mail – [lazarchuktb@tdmu.edu.ua](mailto:lazarchuktb@tdmu.edu.ua)  
<https://orcid.org/0000-0002-3357-1091>

### **Yarema Nadiia Ivanivna**

DSc (Medicine), Professor, Professor of the Department of Internal Medicine No. 1,  
I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine,  
Ternopil, Ukraine  
E-mail – [yaremani@tdmu.edu.ua](mailto:yaremani@tdmu.edu.ua)  
<https://orcid.org/0000-0002-4913-286X>

### **Mykuliak Viktoriia Rostyslavivna**

PhD (Medicine), Associate Professor of the Department of Therapeutics and Family Medicine, Faculty of Postgraduate Education,  
I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine,  
Ternopil, Ukraine  
E-mail – [mykuliakvr@tdmu.edu.ua](mailto:mykuliakvr@tdmu.edu.ua)  
<https://orcid.org/0000-0002-9907-9569>

### **Kotsyuba Oksana Ihorivna**

PhD (Medicine), Associate Professor of the Department of Therapeutics and Family Medicine, Faculty of Postgraduate Education,  
I. Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine,  
Ternopil, Ukraine  
E-mail – [kotsyubaoi@tdmu.edu.ua](mailto:kotsyubaoi@tdmu.edu.ua)  
<https://orcid.org/0000-0002-5400-0589>

**Abstract.** The development of critical and clinical thinking is one of the key strategic objectives of modern medical education. This ability enables medical students and interns to analyse clinical data effectively, make informed decisions, and provide a high standard of medical care. The

article examines contemporary approaches to fostering critical and clinical thinking among students and interns within the context of medical education, including the integration of active learning methods, clinical simulations, problem-based learning, and innovative educational technologies. Particular attention is paid to the interconnection between theoretical training and the practical application of knowledge in the clinical practice of students and interns. The importance of pedagogical support, structured feedback, and the use of digital tools for developing analytical skills in students and interns is emphasised. Key challenges and barriers associated with the implementation of effective critical thinking teaching strategies are examined, including limited resources, insufficient teacher training, and traditional approaches to knowledge assessment. Recent studies are analysed, confirming the positive impact of a comprehensive approach on the competence levels of students and interns. The findings of this study can serve as a basis for improving educational programmes, developing new teaching methods, and enhancing the quality of medical education as a whole.

**Keywords:** critical thinking, clinical thinking, medical education, educational strategies, physician competence, interactive learning methods.

**Розвиток критичного та клінічного мислення у медичній освіті: методики, стратегії та практичні підходи**

**Левчик Олена Іванівна**

кандидат медичних наук, асистент кафедри терапії і сімейної медицини факультету післядипломної освіти,  
Тернопільський національний медичний університет імені І. Я. Горбачевського МОЗ  
України, Тернопіль, Україна  
E-mail – [levchykoi@tdmu.edu.ua](mailto:levchykoi@tdmu.edu.ua)  
<https://orcid.org/0000-0001-8398-492X>

**Лазарчук Тетяна Борисівна**

кандидат медичних наук, доцент, доцент кафедри терапії і сімейної медицини факультету післядипломної освіти,  
Тернопільський національний медичний університет імені І. Я. Горбачевського МОЗ  
України, Тернопіль, Україна  
E-mail – [lazarchuktb@tdmu.edu.ua](mailto:lazarchuktb@tdmu.edu.ua)  
<https://orcid.org/0000-0002-3357-1091>

**Ярема Надія Іванівна**

доктор медичних наук, професор, професор кафедри внутрішньої медицини № 1  
Тернопільський національний медичний університет імені І. Я. Горбачевського МОЗ  
України, Тернопіль, Україна  
E-mail – [yaremani@tdmu.edu.ua](mailto:yaremani@tdmu.edu.ua)  
<https://orcid.org/0000-0002-4913-286X>

**Микуляк Вікторія Ростиславівна**

кандидат медичних наук, доцент кафедри терапії і сімейної медицини факультету післядипломної освіти,  
Тернопільський національний медичний університет імені І. Я. Горбачевського МОЗ  
України, Тернопіль, Україна  
E-mail – [mykuliakvr@tdmu.edu.ua](mailto:mykuliakvr@tdmu.edu.ua)  
<https://orcid.org/0000-0002-9907-9569>

**Коцюба Оксана Ігорівна**

кандидат медичних наук, доцент кафедри терапії і сімейної медицини факультету  
післядипломної освіти  
Тернопільський національний медичний університет імені І. Я. Горбачевського МОЗ  
України, Тернопіль, Україна  
E-mail – [kotsyubaoi@tdmu.edu.ua](mailto:kotsyubaoi@tdmu.edu.ua)  
<https://orcid.org/0000-0002-5400-0589>

Розвиток критичного та клінічного мислення є однією з ключових стратегічних цілей сучасної медичної освіти. Ця здатність дозволяє студентам та лікарям-інтернам ефективно аналізувати клінічні дані, приймати обґрунтовані рішення та забезпечувати високий рівень медичної допомоги. У статті розглядаються сучасні підходи до формування критичного та клінічного мислення у студентів і лікарів-інтернів у контексті медичної освіти, включаючи інтеграцію активних методів навчання, клінічних симуляцій, проблемного навчання та інноваційних освітніх технологій. Особлива увага приділяється взаємозв'язку між теоретичною підготовкою та практичним застосуванням знань у клінічній діяльності студентів і лікарів-інтернів. Підкреслена важливість педагогічної підтримки, структурованого зворотного зв'язку та використання цифрових інструментів для розвитку аналітичних навичок майбутніх медичних фахівців. Розглядаються ключові виклики та бар'єри, пов'язані з імплементацією ефективних стратегій навчання критичного мислення студентів і лікарів-інтернів, зокрема обмежені ресурси, недостатня підготовка викладачів та традиційні підходи до оцінювання знань. Проаналізовані сучасні дослідження, що підтверджують позитивний вплив комплексного підходу на рівень компетентності студентів і лікарів-інтернів. Результати дослідження можуть слугувати основою для удосконалення освітніх програм, розробки нових методик викладання та підвищення якості медичної освіти в цілому.

**Ключові слова:** критичне мислення, клінічне мислення, медична освіта, освітні стратегії, компетентність лікаря, інтерактивні методи навчання.

## Introduction

### Topicality of the problem.

The development of critical and clinical thinking within medical education is one of the key strategic objectives of modern medical universities, as it lays the foundation for the competence of future doctors, enabling them to analyse clinical data effectively, make informed decisions and provide a high standard of medical care [1, 2]. Medical competence is one of the major strategic goals of modern medical universities and begins with developing critical thinking and clinical thinking skills among medical students to analyze the clinical material, make appropriate decisions, rendering high quality medical assistance [3]. The ability to analyze scientific information, to evaluate the quality of information sources, to logically combine knowledge and draw conclusions are the characteristics of critical thinking. Clinical thinking is the combination of theoretical knowledge with practical skills to make a diagnosis, choose the best treatment for a patient, measure the success or effectiveness of treatment, and respond quickly to uncertainty in a clinical situation [4]. Times are rapidly changing in modern medicine, with knowledge constantly expanding, complicated clinical cases, and an overload of information. All of this requires that high-quality skills be developed and become critical in the training of autonomous and responsible specialists. Another factor contributing to the importance of critical and clinical thinking is the medical system's transition to a competency-based approach to learning and to incorporating theory with hands-on practice in medical training [5]. The acquisition of large amounts of information through traditional teaching doesn't always lead to the development of analytical, reflective and problem-oriented competencies. Current pedagogical methods are key on a combination of participative learning, interactive learning, critically-oriented analysis of clinical cases, simulation training and mentoring [6, 7].

For senior students, the process of analysing scientific literature and engaging in discussions or clinical simulations during their studies prepares them to make the right decisions right from the start of their clinical practice [8]. The main objective for all medical interns is the application of

knowledge in practice; the integration of clinical reasoning into real clinical situations, namely: mentoring and reflection, consolidation and development of independence in decision-making within professional practice [9, 10]. This differentiation of approaches facilitates the gradual development of competencies and enables students and interns to work successfully by combining analytical and practical skills, as well as being prepared for professional practice [11, 12]. Current challenges in medical education may be attributed to the growing volume of scientific knowledge, constant changes in clinical procedures, a shortage of available mentors, and variations in clinical practice. To overcome these limitations, pedagogical strategies are integrated that focus on the development of problem-based learning, clinical case analysis, the use of simulation models, modules and interactive learning, as well as systematic mentoring [13]. This holistic approach creates an environment for the development of analytical, reflective and practical skills, shaping doctors for whom rational and effective behaviour comes naturally in a variety of clinical situations [14].

Important idea of the educational process of medical universities is to build critical and clinical thinking in students who will become doctors [15, 16]. Future physicians should develop their professional competence, analytical independence and responsibility in complex clinical scenarios based on ensuring the effective integration of theoretical knowledge with practical skills, differentiated approaches for senior medical students and for interns, employment of evidence-based and interactive teaching methods [17]. These methods future doctors should be investigated further in a systematic fashion to further strengthen the functionality of educational programmes and improve the quality of medical training.

**The purpose** of this article is to describe completely pedagogical tools that will favor the critical and clinical thinking of future physicians-medical doctors.

### **Methodology**

The review was carried out to search, analyse literature related to the development of critical and clinical thinking in medical education. The sources of information were international scientometric and bibliographic databases, such as Scopus, Web of Science, PubMed, Google Scholar. Appropriate keywords and combinations of keywords were used, including: 'clinical thinking', 'clinical reasoning', 'medical education', 'teaching methods', 'learning strategies', 'senior students' and 'interns/residents'. Boolean operators and filters, limitations by language of publishing (English and Ukrainian), and restrictions by the period of publishing (2010–2026) were used to build the search to additionally limit the number of search results to peer-reviewed publications.

Studies that examined the development of critical and/or critical clinical thinking in medical students and/or interns, pedagogical strategies or educational interventions and innovations in medical education courses, and peer reviewed articles, systematic review and meta analysis were included. Exclusion criteria were: studies that were not from medical education and/or clinical training; publications where the full text could not be accessed; and those which were not peer-reviewed or contained only authors perspectives, but not empirical data.

### **Results**

The article by Delavari et al. (2024) presents a scoping review of research into the teaching of clinical reasoning to medical students [18]. The authors analysed 54 articles, describing various educational strategies, including self-explanation, reflection, test-enhanced learning, TBL, thinking aloud, PBL and combinations thereof. Teaching was delivered through a series of prompts or complete clinical cases, with a focus on either the process or knowledge. The results showed that such strategies can improve clinical reasoning and diagnostic accuracy; however, most studies had methodological limitations: small sample sizes, short-term assessments and insufficient control of variables. The article is valuable for systematising approaches and planning future research in medical education.

Recent research in medical education demonstrates that the development of critical thinking, clinical reasoning and clinical judgement is a key objective in the training of competent doctors. Araújo et al. (2024), in a systematic review of 33 articles, demonstrated that pedagogical practices such as cognitive/visual presentation of information, simulations, literature-based work, test-based learning, team-based learning, clinical case discussions, learning from mistakes and gamified

learning, significantly contribute to the development of critical thinking, clinical reasoning and clinical judgement skills and aptitudes in medical students, with critical thinking practices being more commonly applied in the early years of study and clinical reasoning practices in the later years of the medical course [19]. Ge et al. (2025), in a meta-analysis of 13 systematic reviews, demonstrated the effectiveness of problem-based learning in developing critical thinking and clinical skills among medical, dental and nursing students, emphasising that problem-based learning enables students to independently acquire the competencies necessary for professional development, whilst consolidating existing knowledge [20]. Both studies confirm that actively engaging students in the learning process, combining various pedagogical strategies and gradually increasing the complexity of tasks contribute to the more effective development of critical and clinical skills, although the authors note the need for further research to determine the optimal duration, format and sequence of interventions to maximise learning outcomes.

A systematic review and meta-analysis of 50 studies on the teaching of clinical reasoning to medical students [21]. The authors, Wark, S. et al. (2025), found that active, structured and feedback-oriented interventions, such as small-group work, face-to-face seminars, simulations, serious games and online interactive modules, significantly improve clinical reasoning skills, particularly during the clinical years of training. Early interactive exercises in the pre-clinical years can serve as a foundation for further development; however, systematic training in later years is necessary to achieve lasting results. The importance of a spiral curriculum, where the complexity and realism of tasks gradually increase, is emphasised, and it is recommended to combine different learning formats with regular feedback. It is a relevant source for justifying effective strategies for the development of clinical reasoning in medical education.

Cerqueira, A. (2023) systematically analysed the use of Visual Thinking Strategies (VTS) in medical education for students and residents. The methodology involves analysing works of art with the aim of developing observation skills, critical thinking, communication skills and empathy. The review includes 11 studies in which VTS was applied in lecture theatres, museums and online, across various specialisms. The results showed improvements in observational skills and, in some cases, empathy and tolerance of uncertainty. The authors conclude that VTS is effective for developing clinical competencies and should be more widely integrated into training programmes; however, larger, controlled and long-term studies are needed to confirm the effect [22].

Contrasting pedagogical methods for the development of critical and clinical thinking depend on the stage of training: senior-year students training, clinical training for interns. At the senior levels of education process, there are often approaches directed to gaining based skills in analytical reasoning, critical interpretation of scientific knowledge and more gradually introduction of theoretical knowledge into professional practice [23]. Students from years 4-6 are taught problem based learning to facilitate individual and groupwork with clinical scenarios, development of problem based questions, information seeking skills to find evidence and form reasoned clinical conclusions. Use of case method makes a logical analysis of clinical situations with a clear educational objective, promoting the construction of arguments integrating theory and generalisations in practice [24]. Interactive classes such as debates, seminars and modular discussions not just revision but through debate and analysis of evidences they use their critical thinking skill after gradual development. In addition, in the last year more and more aspects of simulation-based learning are being added as a result of the high realism of the models, they enable students to experience areas of practical life in a situation that is as close to real clinical practice as possible, without any risk on the part of the patient [25].

The internship to clinical rotation phase brings about a transition from developing thinking skills through the internship to applying these thinking skills in real-world clinical scenarios. In this phase, the student is mentored as they participate directly in diagnosis and management of patients and provided with immediate assistance by an experienced clinician [26, 27]. At this up until this point, the transfer of knowledge and skill between the student and mentor was significant, however, at this point, the student benefits from the support of the thought process through which the student is able to articulate, analyse and reflect on their decision-making in specific clinical situations as they

transition from relying upon algorithms to successfully utilising independent clinical reasoning. Another benefit of using structured case discussion methods is that the student can improve their skills of forming a hypothesis regarding the correct diagnosis based upon evidence and then be provided with an opportunity to compare that evidence to the findings of the physical examination [28, 29]. Researchers find the mechanisms through which reflection and self-assessment occur are fascinating (e.g., clinical journals, reflective session with a mentor) in promoting a greater awareness of decision-making, recognising performance errors and developing independence as a professional.

Many methods, such as case studies and/or simulations, can be used at both levels, but their purpose and context of use differ. The former are used to build a fundamental framework for analytical thinking during the senior years of study, and are later used to practice the logic of clinical thinking in a controlled learning environment. The latter are used during the internship, in addition to the actual patient interaction, mentoring and reflection that occur there, to move from learning to action and independent decision-making in real clinical settings. This differentiated approach provides a basis for the continuous development of the competencies of future health professionals, so that they develop from independent action at a basic level of competence to the ability to act independently and responsibly in complex/professional settings [30, 31].

In medical education, the methods of teaching are interactive and evidence-based with the intention of promoting critical and clinical thinking skills of future doctors. The Case Method includes the analysis of a given clinical case, allowing the student and intern to consider a number of diagnostic and therapeutic possibilities, make informed decisions and learn analytical skills. Problem-based learning provides opportunities for students to solve problems independently in complex clinical situations, which encourages them to think logically, synthesise information, and analyse the evidence [32]. Interactive learning between students, students and lecturers and between student and students, is achieved through seminars and discussions, which enables argumentation, debating and collective decision making skills to be developed in complex clinical situations. The methods that involve practical skills include simulation training, which enables students to perform clinical procedures, algorithms for decision making and teamwork in a context that closely mimics real clinical situations [33, 34, 35]. Clinical rotations offer hands-on experience in patient care with mentors, fostering independence and responsibility in clinical decision-making and consolidating clinical reasoning skills. Mentoring is one of the most important ways to support the individual development of a student or intern who can obtain feedback, reflect on their own actions and modify their behaviour in clinical scenarios. These reflection activities based on clinical cases enable students to review their decisions, evaluate their impact and improve the way they think about their practice, especially when learning to be more independent and critical in their thinking and practice. This holistic approach to the application of these methods ensures the overall development of cognitive skills, involving both theory and practice, fosters skills of evidence-based thinking, and equips future physicians for successful practice in a complex clinical environment [36, 37, 38].

## **Discussion**

### **Interpretation of results**

A literature review reveals that critical thinking and clinical reasoning in medical students and interns is a multi-stage process and contextual process. Problem Based Learning, case analysis, interactive seminars and evidence appraisal are most useful for senior undergraduate students, helping to develop the analytical and reflective skills needed for their training. Interns and residents, on the other hand, are involved in bedside teaching, mentoring, and reflective practice, clinical rotations, and apply knowledge and reasoning to real-world clinical settings [39, 40, 41].

### **Scientific novelty**

This review advances the field by synthesizing findings across a range of pedagogical approaches and educational stages, demonstrating that some strategies are differentially used with senior students versus interns/residents. It highlights the continuum from development of analytical skills through clinical reasoning with clinical problem solving to independent, accountable health

care practice and presents a conceptual framework for understanding how educational interventions can sequentially develop competencies for the independent responsible medical practitioner.

### Practical significance

These findings include design considerations for curriculum designers and medical educators interested in improving training for future physicians. The review aligns the teaching methods with education stage to support implementation of evidence-based methods, such as problem based learning, case based learning, simulation, interactive seminars and workshops, mentoring and reflective practice.

### Conclusions

Interactive, feedback-oriented pedagogies are required at each of the above developmental stages to foster critical thinking and clinical reasoning in medical students and interns. Analytical reasoning enhancement and integration of theory into clinical practice are appropriate methods for senior students, while practical, supervised experiences to reinforce decision making skills are needed for interns and residents. The current evidence supports a combination of strategies that are applied incrementally and tailored to the stage of the learner in order to promote competent, reflective, and independent future physicians.

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