

Articles

Critical Thinking Development in Medical Schools: Insights from Future Educators

Bisola Christiana Adeleke, Iva Koribská
and Kristýna Raimerová

Abstract

A contemporary issue in education revolves around cultivating critical thinking skills, fostering individuals who possess open-mindedness and unbiased judgment capabilities. Given the complex and varied nature of healthcare practice, the cultivation of critical thinking among medical students is of paramount importance. The purpose of this study was to explore how future teachers of medical professional subjects perceive teaching strategies as tools for developing critical thinking skills in medical students, and to generate a theory grounded in their anticipatory views on their future teaching roles. The study was conducted among the first-year master's degree students in the "Teaching Professional Subjects for Medical Schools" program at Palacký University in Olomouc, Czech Republic. A qualitative research approach based on Grounded Theory was used to analyze participants' insights on problem-based learning (PBL) and reflective practices. The findings reveal the importance of adopting these strategies to better prepare future healthcare professionals for the complexities of clinical practice and to inform teacher education in medical fields.

Keywords: critical thinking, medical education, reflective practice, problem-based learning, teaching strategies, grounded theory.

Rozvoj kritického myšlení ve výuce medicíny: Postřehy budoucích učitelů

Abstrakt

Současná problematika ve vzdělávání se soustředí na rozvoj dovedností kritického myšlení a na formování jedinců, kteří disponují otevřeností a schopností nezaujatého úsudku. Vzhledem ke komplexní a rozmanité povaze zdravotnické praxe je rozvoj kritického myšlení u studentů medicíny mimořádně důležitý. Cílem této studie bylo prozkoumat, jak budoucí učitelé odborných zdravotnických předmětů vnímají výukové strategie jako nástroje pro rozvoj kritického myšlení u studentů medicíny, a vytvořit teorii založenou na jejich představách o jejich budoucí pedagogické roli. Studie byla realizována mezi studenty prvního ročníku magisterského studia programu Učitelství odborných předmětů pro zdravotnické školy na Univerzitě Palackého v Olomouci. Ke zpracování názorů účastníků na problémově orientovanou výuku (problem-based learning, PBL) a reflektivní praxi byl použit kvalitativní výzkumný přístup založený na zakotvené teorii. Zjištění poukazují na význam využívání těchto strategií pro lepší přípravu budoucích zdravotnických pracovníků na komplexnost klinické praxe a pro rozvoj přípravy vzdělavatelů v medicínských oborech.

Klíčová slova: kritické myšlení, lékařské vzdělávání, reflektivní praxe, problémově orientovaná výuka, výukové strategie, zakotvená teorie.

DOI 10.5507/epd.2026.012

Received: 23. 7. 2025 Revised: 20. 11. 2025 Accepted: 20.12.2025

Introduction

The demand for critical thinking skills in education has increased, particularly within medical and health-related fields where practitioners often face complex clinical, ethical and theoretical challenges. This growing emphasis represents a significant pedagogical shift in continental European education systems, which have traditionally relied on encyclopedic, content-heavy teaching approaches (Hanesová & Vančíková, 2023). Despite widespread recognition of the importance of critical thinking in both academic and professional contexts, many medical students continue to struggle with developing these skills, largely due to limited exposure to effective instructional strategies that explicitly foster critical thinking (Incorporating Critical Thinking Skills in Medical Education, 2024). Traditional teaching styles often prioritize knowledge acquisition over analytical reasoning, thereby falling short in cultivating higher-order cognitive skills

essential for modern healthcare practice. As healthcare systems become increasingly complex, critical thinking and problem-solving skills have emerged as indispensable competencies in healthcare professionals (Singh & Butola, 2024). Therefore, understanding how critical thinking is conceptualized and fostered in medical education is important in preparing future practitioners for the demands of 21st-century practice.

1 Concept of Critical Thinking Skills and Dispositions

Critical thinking involves intentional, high-level cognitive processes, which include interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2011). These processes are essential in medical education, where students are required to define a client's problem, examine evidence-based practices, and make choices in care delivery (Alfaro-LeFevre, 2014). Thus, critical thinking functions as a foundational competency that directly influences the quality and safety of care delivery. Within the broader literature on critical thinking, several theoretical frameworks exist; however, this study draws primarily on two influential and complementary models that offer distinct yet synergistic contributions. As illustrated in Figure 1, Peter A. Facione's (2011) expert-consensus model conceptualizes critical thinking as a structured set of cognitive skills derived through the Delphi method. This framework offers conceptual clarity and strong utility for assessment, making it beneficial for evaluating

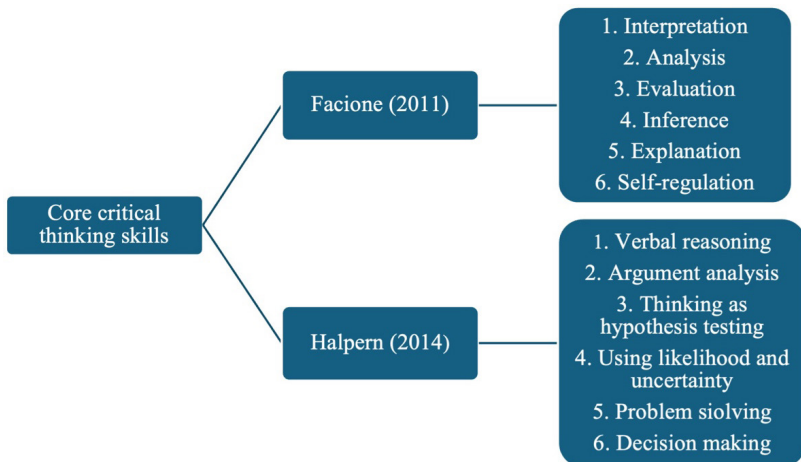


Figure 1
Core critical thinking skills

Adapted from Facione (2011) and Halpern (2014)

learners' critical thinking skills. However, the limitation lies in its minimal attention to how these skills are developed and transferred across learning contexts.

In contrast, Diane F. Halpern's (2014) framework defines critical thinking as the purposeful use of cognitive strategies that increase the likelihood of desirable outcomes. This model foregrounds metacognition, instructional design, and transfer, explicitly addressing how critical thinking can be systematically taught and applied. While Halpern's approach provides clear guidance for pedagogy and real-world application, it places comparatively less emphasis on the systematic measurement of discrete critical thinking skills. Considered together, these models offer a theoretically robust foundation that bridges assessment-oriented and process-oriented approaches to critical thinking. Beyond cognitive skills, critical thinking also requires dispositions, which are significant attitudes (e.g. open-mindedness, truth-seeking, and persistence) that motivate individuals to engage in purposeful thinking (Figure 2). These dispositions are necessary in medical education, as they underpin students' willingness to question assumptions and evaluate evidence objectively.

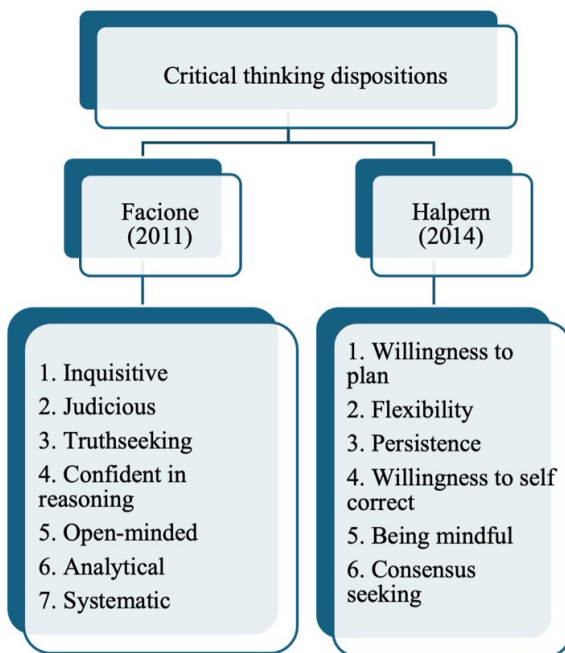


Figure 2
Dispositions for effortful thinking

Adapted from Facione (2011) and Halpern (2014)

2 Developing Critical Thinking in Medical Education Curricula

Curriculum design plays a central role in shaping how learning and teaching activities are enacted within educational institutions, and, by extension, how desired competencies are developed across programs and systems (Majerník et al., 2021). Beyond serving as a structural framework, the curriculum operationalizes educational priorities by specifying learning objectives, instructional approaches, assessment methods, and expected outcomes (El-Astal, 2023). As such, effective curricula extend beyond content transmission to strengthen the development of transferable skills and professional dispositions. Although, traditional medical curricula have often relied on custom memorization over higher-order thinking skills. This misalignment has prompted curricular reforms that position critical thinking as a core medical competency, accompanied by increased emphasis on learner-centered & competency-based models, with evaluations & targeted teaching strategies that promotes analytical reasoning and decision-making (Soltani et al., 2021; Parsons et al., 2021; Burke, 2017; Thomas et al., 2016). Within this curricular shift, frameworks that structure learning progression are essential for intentionally cultivating critical thinking skills.

2.1 Hierarchy of Learning

One of the most widely adopted cognitive frameworks for designing educational objectives and fostering critical thinking is Bloom's Taxonomy. This taxonomy conceptualizes cognitive learning as a hierarchy progressing from lower-order thinking skills (LOTs) to higher-order thinking skills (HOTs) processes (Anderson, Krathwohl & Bloom, 2001). Rather than functioning as a simple classification tool, Bloom's Taxonomy provides a pedagogical scaffold for aligning curriculum goals, instructional strategies, and assessment practices with increasingly complex forms of thinking. The lower-order thinking skills (remembering, understanding, and applying) are primarily focused on acquiring and comprehending factual knowledge. While these skills are foundational, they are insufficient on their own for addressing the complexity and uncertainty inherent in healthcare practice.

In contrast, higher-order thinking skills (analyzing, evaluating, and creating) are relevant for critical thinking, as they require learners to interpret evidence and generate reasoned judgments. Additionally, these HOTs are indispensable for clinical competence and medical professionalism (Trowbridge et al., 2015). Learners typically progress from LOT to HOT as they gain educational experience, clinical exposure, and opportunities for guided reflection (Roets & Maritz, 2017). Moreover, higher-order thinking is inherently complex and multidimensional, enabling students to approach problems from

multiple perspectives and adapt their reasoning to novel situations (Tanner, 2016). Consequently, curricula that aim to foster critical thinking must deliberately incorporate teaching strategies that engage learners in analysis, evaluation, and creation (Misrom et al., 2020; Purnami et al., 2021). Such curricular intentions can only be realized when teaching strategies are purposefully aligned with learning objectives and provide structured opportunities for active application, thereby translating hierarchical learning objectives into meaningful educational practice.

2.2 Teaching Strategies for Developing Critical Thinking Skills

Critical thinking is not an innate feature but a set of cognitive processes that can be taught, explained, and applied through appropriate instructional strategies (Bilgiç et al., 2021). One effective approach involves the early incorporation of hands-on, patient-focused research experiences within the medical school curriculum (Stacpoole et al., 2001). Within experiential learning approaches, problem-based learning (PBL) provides structured opportunities for students to engage with authentic, goal-oriented tasks that require active knowledge application. Such engagement is associated with the development of creative thinking, complex problem-solving skills, and ethical awareness in professional practice (Fu et al., 2023).

In addition to problem-based learning, reflective practice is widely regarded as an important strategy that supports learners' engagement with experience. Reflection involves the deliberate examination of one's experiences to generate insight and awareness (Daryazadeh, et al., 2020). The understanding derived from reflective processes may inform future actions in similar contexts, potentially supporting learning and performance (Sandars, 2009). In clinical settings, reflective practice is often emphasized as a means of supporting thoughtful consideration of complex and ethically challenging situations (Bryan & Babelay, 2009). Theoretically, these strategies are consistent with facilitative and developmental views of teaching, such as those described in Fox's (1983) Shaping and Growing theories. As such, problem-based learning and reflective practice are frequently positioned in medical education as instructional strategies aligned with the development of higher-order thinking, making them specifically relevant to examine from the perspective of future medical educators.

3 Methodology

Building on the theoretical discussion of critical thinking, curriculum design, and teaching strategies presented above, this study seeks to examine how critical thinking is understood and pedagogically positioned by future teachers of medical professional subjects. While prior research has emphasized the importance of problem-based

learning and reflective practice in medical education, less attention has been given to how prospective educators perceive these strategies and anticipate their use in future teaching contexts.

3.1 Research Aim and Questions

Accordingly, the aim of this study was twofold:

1. to explore how future teachers of medical professional subjects conceptualize critical thinking skills, and
2. to investigate how they perceive problem-based learning and reflective practice as teaching strategies for supporting the development of critical thinking in medical students.

In addition, the study aimed to generate a theory grounded in participants' anticipatory perspectives on their future teaching roles, in line with a qualitative, inductive research approach.

To address this aim, the study was guided by the following research questions:

1. How do future teachers of medical professional subjects understand and define critical thinking skills?
2. In what ways do problem-based learning and reflective practice support the development of critical thinking skills in medical students?
3. What challenges do future medical teachers anticipate when implementing these teaching strategies in practice?

3.2 Data Collection and Analytic Strategy

The study was conducted among the first-year master's degree students in the "Teaching Professional Subjects for Medical Schools" program at Palacký University in Olomouc (n=5). The sampling strategy was purposive, focusing on individuals with relevant academic and professional backgrounds. According to Taherdoost (2022), it is important to consider the insights and preciseness of the participants about the topic, and keep the sample size small, since qualitative research does not necessarily intend to generalize the findings. Accordingly, the researchers decided to feature a small number of participants in order to obtain in-depth data for efficient analysis. This study adhered to established ethical principles for research involving human participants. Permission was obtained from the relevant academic program department prior to data collection. Written informed consent was obtained from all participants, and measures were taken to ensure the confidentiality and anonymity of participant responses.

Data were collected through semi-structured interviews, alongside inspiration from Q-methodology, and were analyzed via open, axial, and selective coding (Glaser

& Strauss, 1967). Q methodology was achieved by having participants rank and sort a series of statements (Sandling, 2023). The semi-structured questions were constructed along the lines of the research questions and presented to specialists in the field for validation. Four interviews were conducted virtually, with one of the participants answering in Slovak language. Remote interviews are suitable when there are geographical limits between the participants and interviewers (Taherdoost, 2022). DeepL software was used for language translation, complemented by a bilingual human translator fluent in both Czech and English. Due to the linguistic similarities between Czech and Slovak, the bilingual human translator was also able to identify and correct Slovak-language content, ensuring accurate and grammatically correct translations. A qualitative research approach based on Grounded Theory was used to analyze participants' insights on teaching strategies, alongside the contribution towards the development of critical thinking skills in medical students. The diversity of participants' medical backgrounds enriched their understanding of clinical practice and informed their perspectives. While all participants had experience in healthcare settings, not all had engaged in teaching practice at the time of data collection.

Table 1
Participants' profile and data collection

Participant	Undergraduate Study Program	Prior Teaching VS Healthcare Practice ^a	Language of Interview	Duration of Interview
A	Paramedics	0: 1	English	1 hour, 6 minutes
B	Paramedics	1: 1	English	1 hour, 10 minutes
C	Nursing	1: 1	Slovak	50 minutes
D	Nursing	1: 1	English	40 minutes
E	Nursing	1: 1	English & Czech	40 minutes

Note. This table presents an overview of the participants in the study, including their academic backgrounds, prior experience in teaching or healthcare practice, the language used during the interview, and the length of each interview session.

^a Presence of either prior teaching practice or healthcare practice =1, absence of either prior teaching practice or healthcare practice = 0.

4 Analysis and Interpretation of Data

4.1 Qualitative Coding Results

The results are organized according to the stages of grounded theory coding, indicating an iterative analytic process used to identify patterns, categories, and relationships within the data.

4.1.1 Open coding

During open coding, data were analyzed line by line to generate initial codes grounded in participants' language. Examples of such codes included *communication barriers* and *professional integrity*, among others. A detailed overview of the open coding framework, including the range of initial codes generated during analysis, is provided as Supplementary Material. The higher-order concepts, sub-categories, and analytical categories derived from this process are presented in Table 2 and discussed below.

Medical Professionals' Responsibilities: Participants highlighted the critical role of medical/healthcare professionals in making informed decisions, especially when dealing with uncertain, incomplete or conflicting patient information, and the need to critically evaluate the credibility of patient-reported data.

Participant C stated, "In medicine, there are certain responsibilities, and failure can lead to trial and imprisonment in cases of incorrect measurements and misdiagnosis".

Indeed, the stakes in medicine are incredibly high, as clinical decisions directly affect human lives; consequently, medical/healthcare practice is governed by strict legal and ethical responsibilities.

Thoughts on Critical Thinking Skills: Some of the participants defined critical thinking as the formation of informed opinions based on research and collaboration. Additionally, participants described good critical thinkers as open-minded, communicative, and problem solvers, highlighting the importance of integrating diverse perspectives and evidence into decision-making.

Implementation of Teaching Strategies: Participants discussed using teaching strategies like reflective practice, project-based learning, and interdisciplinary approaches to foster higher-order thinking skills. While some advocated for integrating critical thinking into existing curricula, others proposed creating a dedicated subject for these skills. Reflective practice was seen as a tool for self-regulation and deeper learning.

Teachers' Responsibilities: Teachers were viewed as facilitators who creates motivating and student-centered learning environments. Participant A reflected on teachers' duties in maintaining students' motivation, stating:

“But how do I motivate them? I wouldn't like to give them some extra grades. It is not a good motivation. I want to create a friendly classroom atmosphere. It will be better. They would feel good and if they make a mistake, I won't shout at them.”

Most participants emphasized fostering intrinsic motivation through engaging classroom climates and avoiding punitive measures, opting instead for empathy and encouragement.

Critical Thinking Skills Developed Through Teaching: Participants identified skills such as self-regulation, evaluation, inference, and problem-solving as necessities for medical students. Team-based problem-solving and application of interdisciplinary knowledge were also highlighted as key to developing these competencies.

Challenges of Teaching: Time constraints, student motivation, and resource limitations were noted as major challenges. Some participants expressed concerns about balancing practical teaching strategies with existing curricular demands while ensuring adequate preparation and student engagement.

Table 2
Categorization of concepts

Categories	Sub-categories	Concepts
Medical professionals' responsibilities	<ul style="list-style-type: none"> • Job challenges • Patient-centered care • Quality assurance 	<ul style="list-style-type: none"> • Medical Problems • Collaboration • Risk mitigation • Ethics
Thoughts on critical thinking skills	<ul style="list-style-type: none"> • Critical thinking features 	<ul style="list-style-type: none"> • Information processing • Research
Teaching strategies	<ul style="list-style-type: none"> • Macro-level design • Micro-level implementation 	<ul style="list-style-type: none"> • Curriculum • Lesson • Subject
Teachers' responsibilities	<ul style="list-style-type: none"> • Motivational technique • Instructional management 	<ul style="list-style-type: none"> • Goal alignment • Leadership style • Innovation
Critical thinking skills developed through teaching	<ul style="list-style-type: none"> • Interactive thinking • Reflective thinking 	<ul style="list-style-type: none"> • Interpersonal skills • Intra-personal skills • Process-oriented skills
Challenges of teaching	<ul style="list-style-type: none"> • Human factors • Material & systemic factors 	<ul style="list-style-type: none"> • Students • Lesson & curriculum • Resource • Teacher

4.1.2 Axial coding

Axial coding is the second phase of the constant comparative analysis technique for analyzing qualitative data inductively for purposes of theory development (Scott & Meadough, 2017). Teaching strategies was chosen as the central action (figure 3). It is a key element linked to all other categories and aligns directly with the research problem. The causal conditions included the professional responsibilities of medical practitioners, the skills needed to perform these responsibilities, and the challenges faced while performing these responsibilities. The professional responsibilities and skills mentioned by the participants included a holistic medication approach, continuous monitoring, inquisitiveness, and probabilistic skills, amongst others. Also, some of the challenges faced by medical/healthcare professionals mentioned included the patient's resistance to change, occupational stress and emotional response, misinterpretation of the patient's information, and lack of deep medical examination. The consequences include the critical thinking skills developed in PBL and reflective practice, which is vital for the learner's personal, academic and professional life.

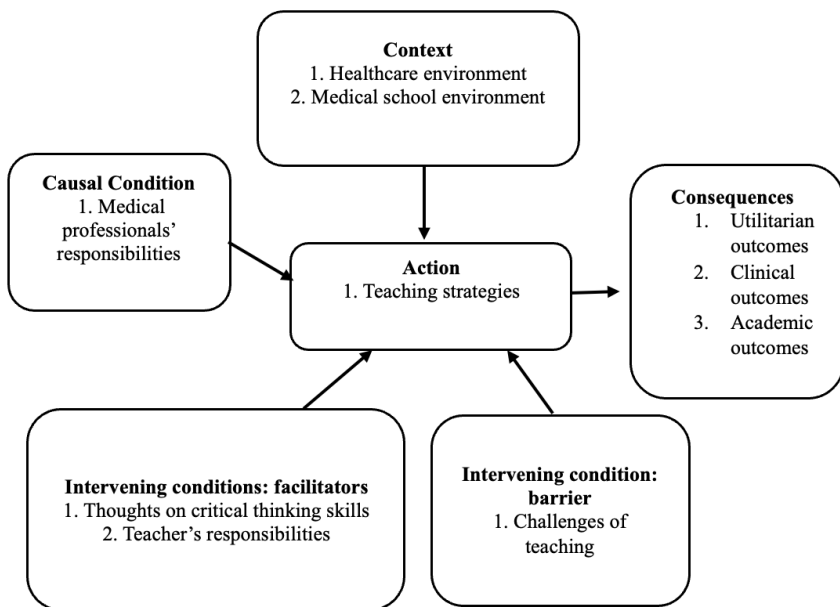


Figure 3

A paradigmatic model of critical thinking development derived from axial coding

4.1.3 Selective Coding

Figure 4 illustrates the paradigmatic model of selective coding, which integrates the key categories that emerged from the data into a theory of how future medical teachers perceive their role in developing students' critical thinking skills. At the center of this model is the core phenomenon: teaching for critical thinking as a professional mandate.

The storyline

This phenomenon (teaching for critical thinking as a professional mandate) is rooted in the causal condition of medical professionals' responsibilities. Practical examples, such as diagnosing complex cases or handling patients' inappropriate communication, illustrated the necessity of these skills for effective decision-making. Participants consistently emphasized that teaching in medical education is not limited to delivering content knowledge but includes the professional obligation to prepare future healthcare providers for the cognitive demands of practice. This sense of responsibility served as the underlying motivation for incorporating critical thinking into their teaching goals.

The process occurs within a defined context, comprising the medical education curriculum, classroom, and healthcare environment. These overlapping domains shape the expectations placed on future educators and influence how teaching for critical thinking is approached. The participants emphasized the importance of integrating critical thinking skills into medical education, with its role in clinical decision-making within the increasingly complex healthcare systems.

Intervening conditions, including teacher's thoughts on critical thinking, teachers' responsibilities, and the challenges of teaching, acts as mediating factors. On one hand, future educators' commitment to fostering critical thinking served as facilitators. On the other hand, practical challenges such as time constraints and variability in student engagement were seen as barriers that could limit the depth or consistency of critical thinking instruction.

In response, future educators plan to engage in specific teaching strategies, such as problem-based learning (PBL) and reflective practice, which embody the action taken to develop critical thinking skills. They described problem-based learning strategies such as simulations, roleplaying, interdisciplinary tasks, project-based lessons, individual and team-based problem solving, case study, gamification, and the incorporation of AI models. Furthermore, reflective practice was highlighted for its role in fostering self-regulation and professional growth.

The consequence of these teaching strategies was the development of critical thinking skills in medical students. Ultimately, future teachers believe these skills translates into enhanced clinical readiness. As one of the most relevant outcomes, participants emphasized that future medical professionals became better equipped to handle

uncertainty in medical practice, an indispensable capacity in a field where complexity and rapid change are constants.

Hence, the grounded theory developed from this study suggests that teaching for critical thinking is a professionally motivated and contextually shaped response to the demands of contemporary medical education, resulting in medical students who are better prepared to navigate the real-world challenges of clinical practice.

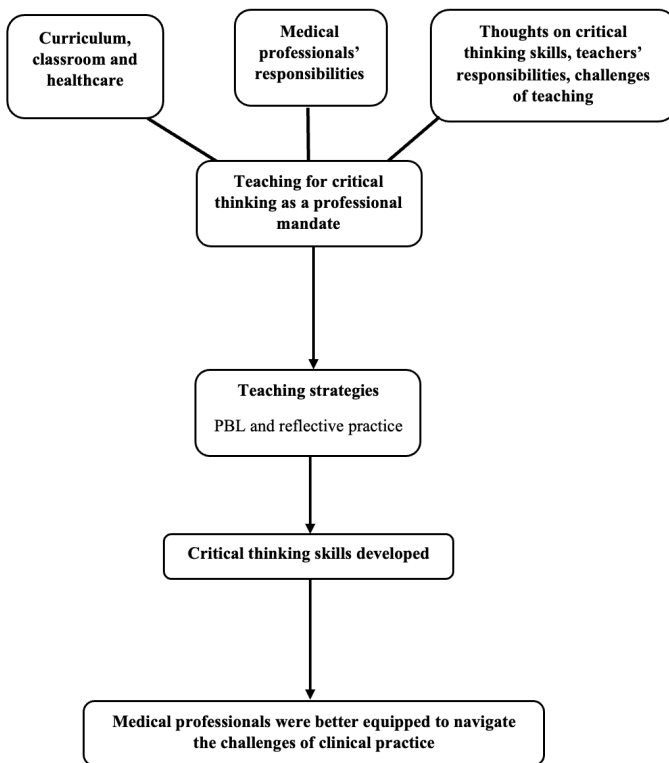


Figure 4

A grounded theory model of critical thinking development in medical education

Model derived through selective coding within a grounded theory approach.

4.2 Discussion of Findings

This section discusses the study findings in relation to the research questions and situates them within the broader context of existing literature.

4.2.1 How do future teachers of medical professional subjects understand and define critical thinking skills?

The answers given by the participants cannot be generalized. Each participant gave a new thought on critical thinking skills and perceived the importance of critical thinking skills differently. Some viewed critical thinking as sorting, verifying, and evaluating information to reach decisions, while others associated it with forming personal opinions based on research and collaboration. These findings align with prior studies by Soltani et al. (2021), Facione (2011), and Halpern (2014), which emphasize critical thinking as a multidimensional skill involving problem-solving and creative thinking.

4.2.2 In what ways do problem-based learning and reflective practice support the development of critical thinking skills in medical students?

Participants highlighted problem-based learning (PBL) and reflective practice as important teaching strategies for developing critical thinking skills. PBL was perceived to foster problem-solving, self-regulation, decision-making, explanation, inference, analysis, verbal reasoning, interpretation, and evaluation, due to students' engagement with structured or complex problems. The interdisciplinary approach of PBL enhances students' ability to work in diverse healthcare settings, as noted by Ahmed et al. (2024). Similarly, reflective practice was recognized for cultivating self-regulation, analysis, inference, explanation, verbal reasoning, thinking as hypothesis testing, problem-solving, and evaluation skills, enabling students to learn from experiences and apply knowledge to future challenges. This perspective aligns with studies by Daryazadeh et al. (2020) and Bryan & Babelay (2009), which affirm that reflection improves decision-making and professional growth in healthcare settings. Importantly, participants described their role as extending beyond knowledge transmission to one of facilitation when implementing these strategies. This facilitative role aligns with Fox's (1983) Shaping and Growing theories of teaching, which conceptualize instruction as guiding learners toward professional standards while supporting creativity, personal development, and intellectual growth. This alignment reveals the relevance of PBL and reflective practice for critical thinking development in medical schools, where professional judgment and interpersonal competencies extend beyond factual knowledge.

4.2.3 What challenges do future medical teachers anticipate when implementing these teaching strategies in practice?

Participants anticipated multiple challenges related to the practical implementation of problem-based learning (PBL) and reflective practice in medical education. Common concerns included sustaining student motivation, managing diverse responses to complex problems, and navigating group dynamics during collaborative learning activities. In the context of PBL, participants also highlighted structural constraints, particularly limited instructional time and the difficulty of designing realistic and pedagogically appropriate medical scenarios. These challenges mirror earlier observations that emphasize the resource-intensive nature of PBL and the demands it places on both instructors and learners (Hung, 2011). Regarding reflective practice, participants noted anticipated students' reluctance to engage in reflective activities. This reluctance was often attributed to discomfort with self-disclosure and fear of vulnerability. In addition, participants expressed uncertainty about their own preparedness to facilitate reflective processes effectively, citing limited training and professional support. These concerns are consistent with prior research indicating that both students and educators may struggle to translate reflective theory into practice, especially in the absence of sustained institutional guidance (Ní Mhurchú & Cantillon, 2024).

Conclusion and Implications

This study aimed to generate a grounded theory explaining how future teachers perceive the development of critical thinking skills through teaching strategies in medical schools. The resulting substantive, context-specific theory conceptualizes critical thinking development as a process shaped by the alignment of medical/healthcare professional responsibilities, teaching strategies (PBL & reflective practice), and the teacher's facilitative role, within existing curricular and institutional constraints. Rather than positioning teaching strategies as inherently effective, the findings clarify how future medical educators anticipate these approaches to function in practice. Problem-based learning and reflective practice are understood as teaching strategies that depend on deliberate instructional design, motivational support, and contextual adaptation, with teachers' responsibilities emerging as a central mediating condition.

From an applied perspective, the findings suggest that more attention could be given to the use of problem-based learning and reflective practice in current medical schools to support the development of students' critical thinking skills. At the institutional level, the study suggests that school management and curriculum designers need to create curricular and organizational conditions that support problem-based learning and reflective practice. In Addition, the grounded theory highlights the need for teacher education programs in healthcare fields to equip current students (who

are preparing for future teaching roles in medical education) with facilitation skills, structured reflective teaching, and the ability to integrate authentic clinical problems into instruction. Together, these findings offer practice-oriented guidance to support the preparation of future medical educators.

Limitations and suggestions for future research

This study focused on reflective practice and problem-based learning, with limited consideration of other teaching strategies. The small, context-specific sample restricts the generalizability of the findings, and the cross-sectional nature limits insight into long-term impact of these strategies. In addition, participants were enrolled in a program that prepares graduates for teaching roles across secondary and higher medical schools, as well as medical, health, and social faculties at the bachelor's degree level, including vocational and in-service training contexts; this should be considered when transferring the findings. Future research should examine a broader range of teaching strategies, including technology-enhanced approaches, and adopt longitudinal designs to assess sustained effects on critical thinking development.

Data Availability

This study was not preregistered. Due to the qualitative nature of the data, the full dataset is not publicly available. De-identified excerpts and supporting materials may be made available from the corresponding author upon reasonable request. Detailed analytic procedures are described in the main text. Documentation of the initial open coding outputs is provided in the supplementary materials. Study materials, including the interview protocol and virtual interview materials, are available on the Open Science Framework (OSF) at [https://osf.io/yg9mj/overview?view_only=992719413f954ff9f965deb9580b0c4].

References

- Abdulazeez, A. R., & Ali, S. A. (2021). Teaching Critical Thinking Skills in Sulaimani City High Schools: Challenges and Obstacles. *Journal of Raparin University*, 8(4), 212–224. [https://doi.org/10.26750/vol\(8\).no\(4\).paper10](https://doi.org/10.26750/vol(8).no(4).paper10)
- Alfaro-Lefevre, R. (2019). *Critical thinking, clinical reasoning and clinical judgment. A practical approach*. (7th ed.). Elsevier Health Sciences
- Anderson, L. W., Krathwohl, D. R., & Bloom, B. S. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives* (Complete ed.). Longman.
- Bhadoria, A. S., Agarwal, S., Mehta, A., Sharma, R., Sinha, S., Bhatia, M., Gupta, B., Saini, L. K., Goyal, B., Hasan, S., Negi, G., & Dhar, P. (2024). Perceptions of medical students on research curriculum: A cross-sectional study. *Indian Journal of Community Health*, 36(1), 137–144. <https://doi.org/10.47203/IJCH.2024.v36i01.022>

- Bilgiç, E. N. Ü., Çam, E., & Hamutoğlu, N. B. (2021). The effects of lifelong learning tendencies on critical thinking and computational thinking skills. *Eskişehir Teknik Üniversitesi Bilim ve Teknoloji Dergisi B – Teorik Bilimler*, 9(Iconat Special Issue 2021), 129–144. <https://doi.org/10.20290/es-tubtdb.1022748>
- Bryan, C. S. & Babelay, A. M. (2009). Building character: A model for reflective practice. *Academic Medicine*, 84(9):1283–1288. <https://doi.org/10.1097/acm.0b013e3181b6a79c>
- Burke, S. M. (2017). Cultivating critical thinking using virtual interactive case studies. *Journal of Pediatric Nursing*, 33, 94–96. <https://doi.org/10.1016/j.pedn.2016.12.001>
- Daryazadeh, S., Yamani, N., & Adibi, P. (2020). A modified tool for “reflective practice” in medical education: Adaptation of the REFLECT rubric in Persian. *Journal of education and health promotion*, 9, 24. https://doi.org/10.4103/jehp.jehp_532_19
- El-Astal, M. (2023). What is Curriculum? Building a Broader Understanding of the Term. *Journal of Curriculum and Teaching*, 12(6), 188–196. <https://doi.org/10.5430/jct.v12n6p188>
- Ellis, L. D. (2024). *Incorporating critical thinking skills in medical education*. HMS Postgraduate Education. <https://learn.hms.harvard.edu/insights/all-insights/incorporating-critical-thinking-skills-medical-education>
- Epstein, R. M., & Hundert, E. M (2002). Defining and assessing professional competence. *JAMA*, 287(2), 226–235. <https://doi.org/10.1001/jama.287.2.226>
- Facione, P. (2011). *Critical thinking: What it is and why it counts*. Insight Assessment. http://dept.clcillinois.edu/vpe/gened/pdf/CriticalThinking_Facione.pdf
- Fox, D. (1983). Personal theories of teaching. *Studies in Higher Education*, 8(2), 151–163. <https://doi.org/10.1080/03075078312331379014>
- Fu, D. Q., Huang, Y. Q., Que, Y. H., Hong, Y., & Lin, J. Q. (2023). Factors affecting the scientific research ability and the corresponding countermeasures in clinical postgraduates. *BMC Medical Education*, 23(1), 309. <https://doi.org/10.1186/s12909-023-04261-w>
- Glaser & Strauss (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Sociology Press.
- Halpern, D. (2014). *Thought and knowledge: An introduction to critical thinking*. (5th ed.). Psychology Press.
- Hanesová, D., & Vančíková, K. (2023). Development of critical thinking – wishful thinking or reality in elementary schools. In M. Carmo (Ed.), *Education and new developments* (Vol. 1, pp. 603–607). <https://doi.org/10.36315/2023v1end133>
- Hung, W. (2011). Theory to reality: a few issues in implementing problem-based learning. *Educational Technology Research and Development*, 59(4), 529–552. <https://doi.org/10.1007/s11423-011-9198-1>
- Majerník, J., Kačmaríková, A., Komenda, M., Kononowicz, A. A., Kocurek, A., Stalmach-Przygoda, A., Balcerzak, Ł., Hege, I., & Ciureanu, I. (2021). Development and implementation of an online platform for curriculum mapping in medical education. *Bio-Algorithms and Med-Systems*, 18(1), 1–11. <https://doi.org/10.1515/bams-2021-0143>
- Misrom, N. S., Abdurrahman, M. S., Abdullah, A. H., Osman, S., Hamzah, M. H., & Fauzan, A. (2020). Enhancing students’ higher-order thinking skills (HOTS) through an inductive reasoning strategy using geogebra. *International Journal of Emerging Technologies in Learning*, 15(3), 156–179.
- Ní Mhurchú, M., & Cantillon, P. (2024). Reflective practice in medicine: The hidden curriculum challenge. *The Clinical Teacher*, 21(2), e13682. <https://doi.org/10.1111/tct.13682>
- Parsons, A. S., Kon, R.H., Plews-Ogan, M., & Gusic, M. E. (2021). You can have both: Coaching to promote clinical competency and professional identity formation. *Perspectives on Medical Education*, 10(1), 57–63. <https://doi.org/10.1007/s40037-020-00612-1>

- Roets, L., & Maritz, J. (2017). Facilitating the development of higher-order thinking skills (HOTS) of novice nursing postgraduates in Africa. *Nurse Education Today*, 49, 51–56. <https://doi.org/10.1016/j.nedt.2016.11.005>
- Sandling J. (2023). *Q methodology: complete beginner's guide*. https://jonathansandling.com/q-methodology-complete-beginners-guide/?utm_content=cmp-true
- Sanders, J. (2009). The use of reflection in medical education: AMEE Guide No. 44. *Medical Teacher*, 31(8), 685–695. <https://doi.org/10.1080/01421590903050374>
- Singh, M. K., & Butola, K. S. (2024). Correlations between Critical Thinking and Problem-Solving skills in Critical Situations among nursing students. *International Journal of Health Sciences and Research*, 14(2), 118–124. <https://doi.org/10.52403/ijhsr.20240215>
- Soltani, A., Mafinejad, M. K., Tajik, M., Moosapour, H., Bayat, T., & Mohseni, F. (2021). Effects of a curriculum integrating critical thinking on medical students' critical thinking ability in Iran: a quasi-experimental study. *Journal of Educational Evaluation for Health Professions*, 18, 14. <https://doi.org/10.3352/jeehp.2021.18.14>
- Stacpoole, P. W., Fisher, W. R., Flotte, T. R., Geiser, E. A., Theriaque, D. W., Hutson, A. D. (2001). Teaching hypothesis-oriented thinking to medical students: the University of Florida's clinical investigation program. *Academic Medicine*, 76(3), 287–292. <https://doi.org/10.1097/00001888-200103000-00022>
- Taherdoost, H. (2022). How to conduct an effective interview: A guide to interview design in research study. *International Journal of Academic Research in Management*, 11(1), 39–51. https://www.researchgate.net/publication/359596183_How_to_Conduct_an_Effective_Interview_A_Guide_to_Interview_Design_in_Research_Study
- Thomas, P. A., Kern, D. E., Hughes, M. T., & Chen, B. Y. (Eds.). (2016). *Curriculum development for medical education: A six-step approach* (3rd ed.). Johns Hopkins University Press.
- Trowbridge, R. L., Rencic, J. J., & Durning, S. J. (Eds.). (2015). *Teaching clinical reasoning*. American College of Physicians.
- Van Dijk, E. E., Van Tartwijk, J., Van der Schaaf, M. F., & Kluijtmans, M. (2020). What makes an expert university teacher? A systematic review and synthesis of frameworks for teacher expertise in higher education. *Educational Research Review*, 31, 100365. <https://doi.org/10.1016/j.edurev.2020.100365>
- Wald, H. S., Borkan, J., Taylor, J., Anthony, D., & Reis, S. (2012). Fostering and evaluating reflective capacity in medical education: Developing the REFLECT rubric for assessing reflective writing. *Academic Medicine*, 87(1), 41–50. <https://doi.org/10.1097/acm.0b013e31823b55fa>

Authorship Contribution Statement

Bisola Adeleke led the study's conceptualization, methodology design, and data analysis. Iva Koribská provided critical advisory input, guiding the research framework and refining the study's theoretical foundations. Kristýna Raimerová contributed substantially to linguistic accuracy by translating and adapting Czech/Slovak materials into English and vice-versa, ensuring clarity and precision in cross-linguistic interpretations. All authors contributed to the revision of the manuscript and approved the final version for submission.

Contact:

Mgr. Bisola C. Adeleke

Department of Health and Kinesiology, College of Applied Health Sciences, University of Illinois
at Urbana-Champaign,

1206 S 4th St, Champaign, IL, 61820, USA.

E-mail: bisolaa2@illinois.edu

Mgr. Iva Koribská, PhD.

Institute of Education and Social Sciences, Faculty of Education, Palacký University in Olomouc,
Žižkovo nám. 5, 77900 Olomouc, Czech Republic.

E-mail: iva.koribska@upol.cz

Bisola Christiana Adeleke is a Doctoral Student at the University of Illinois, Urbana-Champaign. Her research interests include critical thinking, healthcare workforce development, health technology, intrinsic capacity, and gerontology.

Iva Koribská works as an assistant professor at the Institute of Pedagogy and Social Studies, where she engages with students in courses on andragogy, gerontagogy, critical thinking, and human resource management.

Kristýna Raimerová is a graduate of Palacký University, Olomouc, Czech Republic. Her academic background spans Economics and Management, along with Andragogy.