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Facilitating Critical Thinking in Undergraduate Medical Education: An Integrated Narrative Review

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Abstract

Critical thinking is a central goal of undergraduate medical education because students must learn to interpret evidence, question assumptions, compare competing explanations, and justify decisions under conditions of uncertainty. Although the literature contains many accounts of barriers to critical thinking, the evidence on conditions that facilitate its development is more dispersed across studies of active learning, clinical reasoning, feedback, student engagement, higher-order thinking, and faculty facilitation. This focused narrative review integrates that literature into three cross-cutting domains rather than treating individual teaching techniques as isolated facilitators. The first domain is pedagogical architecture: active, problem-oriented, and cognitively demanding learning designs that require students to analyze information, explain relationships, and make decisions. The second is the relational learning climate: psychological safety, dialogic feedback, questioning, and guided reflection that make it possible for learners to expose incomplete reasoning and revise it. The third is faculty cognitive apprenticeship: making expert reasoning visible through facilitation, modeling, think-aloud explanation, mentoring, and deliber-

ate scaffolding. Evidence is strongest for active and problem-centered approaches, including problem-based learning and concept mapping, while the evidence for relational climate and role modeling is more qualitative and context-dependent. The review therefore argues against treating critical-thinking development as the product of any single method. Instead, critical thinking is most plausibly supported when curriculum design, feedback practices, learner participation, and faculty reasoning are aligned. The review also identifies important limitations in the field, including inconsistent definitions of critical thinking, frequent conflation with clinical reasoning or academic performance, reliance on single-site studies for several relational facilitators, and limited cross-cultural or longitudinal evidence. Future research should test integrated models of facilitation using multi-institutional and mixed-methods designs and should distinguish clearly between critical-thinking skills, dispositions, clinical reasoning, and general learning outcomes.

Keywords: critical thinking, undergraduate medical education, active learning, feedback, clinical reasoning, faculty facilitation, narrative review

1. INTRODUCTION

Critical thinking is widely regarded as an essential outcome of medical education because future physicians must interpret evidence, compare alternative explanations, recognize assumptions, evaluate the quality of information, and make defensible judgments under conditions of uncertainty. A commonly cited consensus definition describes critical thinking as purposeful, self-regulatory judgment involving interpretation, analysis, evaluation, inference, and explanation [1]. This formulation is useful for medical education because it emphasizes both cognitive operations and the disciplined judgment required to apply them.

The educational importance of critical thinking extends beyond examination performance. Clinical decisions require learners to move from factual knowledge to interpretation, prioritization, and action. Nevertheless, *critical thinking*, *clinical reasoning*, and *clinical judgment* should not be treated as interchangeable terms. Critical thinking is a broad set of evaluative and inferential processes; clinical reasoning applies cognitive and metacognitive processes to patient problems; and clinical judgment additionally incorporates action within a specific clinical context. This distinction matters because medical-education studies often use these constructs together or use one as a proxy for another. A recent systematic review of undergraduate medical education identified substantial variation in both the pedagogies used to develop critical thinking and the outcomes used to evaluate it [2].

The wider educational literature nevertheless demonstrates that critical thinking can be taught. Abrami and colleagues' meta-analysis of 341 effect sizes found that instructional interventions produced a positive overall effect on critical-thinking outcomes and, importantly, that opportunities for dialogue, authentic or situated problems, and mentoring were associated with stronger results [3]. Medical education provides a particularly important setting in which to examine these conditions because active learning, case discussion, simulation, concept mapping, feedback, and clinical supervision are already embedded in many curricula.

Much of the medical-education literature has historically emphasized barriers: content-heavy curricula, passive teaching, limited student participation, inadequate faculty preparation, and assessment systems that reward recall more readily than explanation. More recent work has begun to examine the enabling side of the problem. Araújo and colleagues' systematic review identified multiple pedagogical practices associated with critical-thinking or clinical-reasoning development, including simulation, clinical case discussion, cognitive or visual representation, team-based learning, error-based learning, and other active approaches [2]. Faculty interviews similarly indicate that educators perceive interactive teaching, questioning, institutional support, and student engagement as central to cultivating critical thinking [4].

The present review builds on this shift from barriers to facilitators. A previous qualitative study by the present author identified five recurring facilitators—supportive learning environments, interactive teaching strategies, constructive feedback, curiosity, and role modeling—among a small group of students and faculty [5]. Because that study was qualitative, single-site, and based on thirteen participants, its themes should not be treated as independent proof of a general framework. The purpose of the present article is therefore not to reproduce those five themes as separate sections, but to test their broader plausibility against external evidence and reorganize the literature into a more integrated explanatory structure.

The review addresses two questions. First, which educational conditions are most consistently associated with the development of critical thinking or closely related reasoning processes in undergraduate medical education? Second, how do these conditions interact such that the effectiveness of one facilitator may depend on the presence of others? The synthesis is organized around three cross-cutting domains: pedagogical architecture, relational learning climate, and faculty cognitive apprenticeship.

2. REVIEW APPROACH

This article is a focused narrative review rather than a systematic review or scoping review. It does not claim exhaustive retrieval of all publications on critical thinking in medical education. Sources were selected for their direct relevance to critical-thinking development or to mechanisms closely connected with it, including active and problem-based learning, concept mapping, self-directed learning, feedback, facilitation, student engagement, clinical reasoning, and role modeling. Priority was given to systematic reviews, meta-analyses, umbrella reviews, and empirical studies in medical or health-professions education, with selected general-education evidence retained where it directly informed the conceptual framework.

The synthesis was deliberately organized by mechanism rather than by teaching method. This approach was adopted for two reasons. First, individual educational techniques frequently contain several active ingredients at once. Problem-based learning, for example, combines authentic problems, discussion, self-directed inquiry, peer interaction, and facilitator questioning. Second, the same relational condition may influence several methods. Psychological safety, for instance, can affect whether students participate in case discussion, expose uncertainty during feedback, or challenge an instructor's interpretation.

The review also distinguishes direct evidence from adjacent evidence. Studies that explicitly measured critical-thinking

outcomes were treated as the strongest support for claims about critical thinking. Studies of clinical reasoning, evaluative judgment, engagement, or general academic performance were used more cautiously to illuminate plausible mechanisms rather than as direct proof of critical-thinking improvement. This distinction is essential because the field often uses overlapping constructs and outcome measures.

Table 1 summarizes the three-domain framework used in the present synthesis.

Table 1. *Integrated framework for facilitating critical thinking in undergraduate medical education*

Domain	Representative educational practices	Principal contribution to critical thinking	Evidence caution
Pedagogical architecture	Problem-based learning; case discussion; simulation; concept mapping; self-directed inquiry; cognitively demanding tasks	Requires learners to analyze information, compare explanations, organize relationships, justify decisions, and apply knowledge to authentic problems	Evidence is comparatively strong, but studies vary in definitions, interventions, and outcome measures
Relational learning climate	Psychological safety; dialogic feedback; questioning; guided reflection; peer discussion; supportive facilitation	Makes incomplete reasoning discussable, creates opportunities for revision, and supports learner participation in uncertainty and disagreement	Much of the evidence is qualitative or measures engagement and evaluative judgment rather than critical thinking directly
Faculty cognitive apprenticeship	Think-aloud reasoning; making expert thinking visible; modeling uncertainty; scaffolding; mentoring; facilitation	Gives learners access to otherwise tacit reasoning processes and demonstrates how evidence is weighed, uncertainty managed, and conclusions revised	Direct evidence for critical-thinking outcomes is less extensive than evidence for clinical reasoning, supervision, and professional learning

3. INTEGRATED SYNTHESIS

Pedagogical architecture: designing tasks that require thinking rather than recall. The most consistent evidence concerns the design of learning activities. Critical thinking is unlikely to develop when students can succeed primarily through recognition or reproduction of information. In contrast, active and problem-oriented approaches create situations in which learners must select relevant information, generate hypotheses, connect concepts, justify interpretations, and revise conclusions. Araújo and colleagues' systematic review found that pedagogical practices including simulation, clinical case discussion, cognitive or visual representation, team-based learning, error-based learning, and game-based approaches were associated with improvement in critical-thinking or clinical-reasoning outcomes [2].

Problem-based learning is the most extensively synthesized example. An umbrella review by Ge and colleagues drew together thirteen systematic reviews and meta-analyses and concluded that problem-based learning can improve critical thinking and clinical skills, while also emphasizing the need for further evidence because of heterogeneity across included studies [6]. This qualification is important. PBL should not be interpreted as automatically effective simply because it is labeled "student-centered." Its impact depends on the quality of problems, the facilitator's questioning, group dynamics, learner preparation, and whether assessment rewards the same reasoning processes that teaching is intended to develop.

Concept mapping offers a more specific example of cognitively demanding representation. Fonseca and colleagues' BEME systematic review included thirty-nine studies and concluded that concept maps appear to support critical thinking by helping learners integrate knowledge and represent relationships among ideas [7]. Concept mapping is educationally relevant because it externalizes the structure of thinking. Learners must decide which concepts are central, which are subordinate, and how relationships should be represented. This is more demanding than copying notes because it requires selection, hierarchy, and explanation.

Self-directed learning provides adjacent evidence. Aulakh and colleagues' systematic review and meta-analysis found that self-directed approaches can improve cognitive performance in undergraduate medical education and may also support autonomy, curiosity, and self-regulation [8]. These outcomes should not be treated as direct measures of critical thinking, but they are relevant because learners who monitor their own understanding and identify gaps are better positioned to engage in evaluative reasoning.

A broader health-professions synthesis reaches a similar conclusion. Gheshlaghi Azar and colleagues identified a range of instructional approaches for higher-order thinking and emphasized that critical-thinking development depends on purposeful educational design rather than on exposure to disciplinary content alone [9]. The common mechanism across these approaches is not activity for its own sake. It is the requirement that learners do intellectual work that cannot be completed by recall alone.

Relational learning climate: making reasoning discussable and revisable. The second domain concerns the social conditions under which students are willing to expose their reasoning. Critical thinking is partly an internal cognitive process, but in education it develops through public acts: asking questions, explaining an interpretation, defending a choice, recognizing a mistake, and revising an argument. Students are less likely to perform these acts when participation carries a high interpersonal cost.

Direct quantitative evidence linking psychological safety to standardized critical-thinking outcomes remains limited. However, several strands of medical-education evidence converge on the importance of supportive facilitation and active participation. In an interview study of expert medical teachers, Grijpma and colleagues found that high student engagement in small-group active learning involved the creation of a supportive learning environment, a personal educational approach,

and active facilitation of the learning process [10]. A scoping review of case-based learning similarly identified prompting, guiding, effective questioning, group management, and feedback as core elements of facilitation [11]. Faculty interviewed by Batarfi and Agha also identified student engagement, active-learning approaches, and institutional support as central to the development of critical thinking in medical education [4].

These findings support a cautious interpretation: psychological safety and supportive facilitation may be enabling conditions rather than stand-alone interventions. Their role is to make the cognitive processes of critical thinking visible enough to be practiced and corrected. A learner who never states an uncertain interpretation cannot receive feedback on the quality of that interpretation. A learner who fears embarrassment may choose silence over hypothesis generation. In this sense, relational climate affects access to the very behaviors through which reasoning is practiced.

Feedback is especially important because it can either close or extend a reasoning process. Feedback that only announces correctness may help with error detection but does not necessarily reveal why an error occurred. In contrast, feedback that asks learners to reconstruct how they reached a conclusion can turn assessment into an opportunity for metacognition. Maqsood and colleagues' randomized study found that feedback integrated with reflection produced stronger deep-learning and higher-order assessment outcomes than reflection alone in undergraduate medical students [12]. Although this study did not isolate critical thinking as a single construct, it supports the educational value of combining external feedback with learner reflection.

Work on clinical placements provides a complementary perspective. Nicola-Richmond and colleagues found that students develop evaluative judgment by seeking, interpreting, and acting on feedback from multiple sources, but that this process requires scaffolding because the information students receive can be fragmented or contradictory [13]. Evaluative judgment is not identical to critical thinking, yet the underlying process—judging the quality of one's own performance and deciding how to improve it—is closely aligned with self-regulatory aspects of critical thought.

Questioning and curiosity fit within the same relational domain. The important distinction is between asking questions as a superficial participation requirement and using questions to expose assumptions, seek evidence, or test alternative explanations. The general meta-analytic literature on critical-thinking instruction identifies dialogue and authentic problems as productive conditions [3]. In medical education, the most defensible conclusion is therefore not that "curiosity" itself has been proven to cause critical thinking, but that learning environments which permit sustained questioning create more opportunities for evaluative reasoning than environments in which answers are transmitted as settled facts.

The previous qualitative study by Al-Bader identified supportive environments, constructive feedback, curiosity, interactive teaching, and role modeling as perceived facilitators among a small group of medical students and faculty [5]. The value of that study in the present synthesis is explanatory rather than confirmatory. Its themes illustrate how participants describe facilitation at the micro-level, while the stronger external reviews and empirical studies above provide the broader evidence base.

Faculty cognitive apprenticeship: making expert reasoning visible. The third domain concerns what learners can observe about expert thinking. Clinical reasoning is difficult to teach partly because expertise often becomes tacit. Experienced clinicians may recognize patterns, prioritize information, and discard implausible explanations rapidly without articulating the intermediate steps that a novice needs to see. Educational strategies that make this thinking visible can therefore function as cognitive scaffolding.

Bowen's review of educational strategies for clinical diagnostic reasoning emphasized the importance of explicit teaching of reasoning processes rather than assuming that clinical exposure alone will produce expertise [14]. Delany and Golding operationalized this idea in an action-research project in which clinical educators identified and articulated their own reasoning processes, translated them into visible thinking routines, and used these routines to scaffold learners' reasoning [15]. Their findings suggest that making expert thinking accessible can help both educators and learners attend more explicitly to the structure of reasoning.

Role modeling is related but should be interpreted carefully. A systematic scoping review by Koh and colleagues demonstrates the broad influence of role modeling on how medical learners absorb professional beliefs, values, practices, and patterns of conduct [16]. Patel and colleagues likewise argue that modern medical learners construct role models from multiple sources and that educators should become more conscious of the behaviors they model [17]. These studies are not direct demonstrations that role modeling raises critical-thinking scores. Their relevance lies in showing that learners observe not only what senior clinicians decide but how they approach uncertainty, evidence, disagreement, and error.

For critical-thinking development, the most useful form of role modeling may therefore be visible reasoning rather than prestige or imitation. Faculty can think aloud through a differential diagnosis, state what evidence changed their view, identify an assumption they are uncertain about, compare two plausible options, or explain why they revised an initial judgment. Such practices convert expert cognition from a hidden outcome into an observable process.

The three domains are interdependent rather than additive. The central implication of the synthesis is that facilitators should not be understood as independent ingredients. An active-learning session can remain cognitively shallow if the task requires only recall. A high-quality case can fail if students are unwilling to speak. Feedback can be

technically accurate yet educationally weak if it does not engage the learner's reasoning. A faculty member can model sophisticated thinking, but students may not benefit if the reasoning remains implicit.

This interdependence helps explain why educational studies sometimes produce inconsistent results even when they evaluate interventions with the same label. "Problem-based learning," "flipped classroom," "case-based learning," or "simulation" describes a structure, not the full learning process. Outcomes depend on the relationship between task design, facilitation, participation, feedback, and assessment. The critical-thinking literature is therefore better interpreted at the level of mechanisms than at the level of branded teaching methods.

The evidence also varies in strength across domains. Active and problem-centered pedagogies are supported by systematic reviews and meta-analytic evidence, although heterogeneity remains substantial [2, 6]. Concept mapping has direct systematic-review support in undergraduate medical education [7]. By comparison, psychological safety, curiosity, and visible faculty reasoning are supported more often by qualitative, action-research, and adjacent evidence. These should not be dismissed; qualitative evidence is particularly useful for understanding how facilitation works. However, claims about effect size or causal impact should remain restrained.

This uneven evidence base has implications for curriculum design. Medical schools should avoid treating critical thinking as a stand-alone course outcome that can be achieved by adding a single method. A more coherent strategy would align learning tasks, faculty facilitation, feedback, and assessment. Students should repeatedly encounter authentic or ill-structured problems that require explanation rather than recall; faculty should receive development in questioning, feedback, and facilitation; reasoning should be made visible in classrooms and clinical settings; and assessments should reward interpretation, justification, and revision rather than only final answers.

Faculty development is especially important because implementation quality determines whether structural reforms produce the intended cognitive work. Grijpma and colleagues show that expert small-group facilitation involves deliberate practices rather than generic enthusiasm [10], while Hammond and colleagues identify specific facilitation behaviors such as prompting, guiding, asking effective questions, and giving feedback [11]. The implication is practical: curriculum reform without faculty development risks changing the timetable without changing the thinking.

Several limitations of the evidence base should guide future research. First, definitions and measures of critical thinking vary substantially. Studies frequently combine critical thinking with clinical reasoning, higher-order thinking, problem solving, or academic achievement, making direct comparison difficult. Second, several studies report immediate educational outcomes rather than long-term transfer into clinical decision making. Third, relational facilitators such as psychological safety, curiosity, and role modeling are often studied qualitatively or indirectly. Fourth, many studies are single-site and culturally specific, limiting confidence that the same facilitation practices operate identically across educational systems.

Future work should therefore move beyond asking whether isolated teaching methods "work." Multi-institutional studies should test integrated models in which task design, facilitation, feedback, and assessment are specified separately. Mixed-methods designs would be particularly valuable because standardized critical-thinking measures can estimate change while qualitative data can explain how learners experience the mechanisms producing that change. Longitudinal research is also needed to determine whether improvements persist and transfer into clinical environments. Finally, authors should distinguish critical-thinking skills and dispositions from clinical reasoning and general academic performance rather than using these outcomes interchangeably.

4. CONCLUSION

The literature supports a shift from viewing critical thinking as the product of a single teaching strategy toward understanding it as the outcome of an aligned educational environment. Three domains recur across the strongest and most relevant evidence: pedagogical architecture that requires analysis and decision making, a relational learning climate that makes reasoning discussable and revisable, and faculty cognitive apprenticeship that makes expert thinking visible.

The strongest direct evidence concerns active and problem-centered approaches, including problem-based learning and concept mapping. Evidence for feedback, supportive facilitation, questioning, and visible reasoning is also educationally persuasive, but more often qualitative, context-dependent, or linked to adjacent outcomes such as engagement, evaluative judgment, and clinical reasoning. For this reason, these facilitators should be described as enabling conditions rather than as independently proven causal interventions.

For undergraduate medical curricula, the practical implication is integration. Critical thinking is more likely to develop when learners repeatedly encounter authentic problems, are expected to explain rather than merely answer, receive feedback on reasoning rather than correctness alone, can question and revise ideas without excessive interpersonal cost, and observe faculty make their own reasoning processes visible. Future research should test this integrated model directly and should use clearer construct definitions, multi-institutional samples, longitudinal designs, and mixed methods capable of linking educational process with durable reasoning outcomes.

AUTHOR CONTRIBUTION

The author conceived the review, synthesized the literature, prepared the manuscript, critically revised its content, and approved the final version.

CONFLICTS OF INTEREST

The author declares no conflicts of interest.

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DATA AVAILABILITY

No new datasets were generated for this narrative review. The evidence discussed in the manuscript is drawn from the published sources cited in the reference list.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During preparation of the manuscript, the author used ChatGPT to support language editing, structural refinement, and readability. The author subsequently reviewed and revised the manuscript and takes full responsibility for the accuracy, interpretation, integrity, and final content of the work.

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