

Milestones of Critical Thinking: A Developmental Model for Medicine and Nursing

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Abstract

Critical thinking is essential to a health professional's competence to assess, diagnose, and care for patients. Defined as the ability to apply higher-order cognitive skills (conceptualization, analysis, evaluation) and the disposition to be deliberate about thinking (being open-minded or intellectually honest) that lead to action that is logical and appropriate, critical thinking represents a "meta-competency" that transcends other knowledge, skills, abilities, and behaviors required in health care professions. Despite its importance, the developmental stages of critical

thinking have not been delineated for nurses and physicians. As part of a task force of educators who considered different developmental stage theories, the authors have iteratively refined and proposed milestones in critical thinking. The attributes associated with unreflective, beginning, practicing, advanced, accomplished, and challenged critical thinkers are conceived as independent of an individual's level of training. Depending on circumstances and environmental factors, even the most experienced clinician may demonstrate attributes associated with a challenged

thinker. The authors use the illustrative case of a patient with abdominal pain to demonstrate how critical thinking may manifest in learners at different stages of development, analyzing how the learner at each stage applies information obtained in the patient interaction to arrive at a differential diagnosis and plan for evaluation. The authors share important considerations and provide this work as a foundation for the development of effective approaches to teaching and promoting critical thinking and to establishing expectations for learners in this essential meta-competency.

Critical thinking, a key component of competence across all domains, underlies health professionals' abilities and performance¹⁻³; its deficit leads to cognitive biases that contribute to diagnostic and therapeutic errors.^{4,5} Decades of empirical and theoretical literature in health professions education have conceptualized critical thinking as "clinical judgment," "clinical reasoning," "diagnostic thinking," "problem solving," and "type 2 thinking"—constructs that emphasize the mental processes that clinicians use to think through problems and arrive at decisions.⁶⁻¹⁰ However, the following definition of critical thinking focuses on both qualities and habits of mind: "the ability to apply higher-order cognitive skills (conceptualization, analysis, evaluation) and the disposition to be deliberate about thinking (being

open-minded or intellectually honest) that lead to action that is logical and appropriate" (adapted from Scriven and Paul¹¹). The primacy of critical thinking and the potential harm to patients when it is lacking support the premise that it should be elevated as its own competency.

Furthermore, critical thinking is increasingly important in an era when biomedical science is progressing exponentially and knowledge acquisition alone is insufficient for practitioners to function in complex clinical environments. As noted by Lawrence Summers, higher education in the future "will be more about how to process and use information and less about imparting it. [I]n a world where the entire Library of Congress will soon be accessible on a mobile device ... factual mastery will become less and less important."¹² Health professionals must also contend with a great deal of misinformation and the fact that many aspects of scientific knowledge are riddled with uncertainty. Defining expertise in health care must extend beyond the traditional static notions of "knowledge plus experience" to a dynamic model of thought that, while still based on a thorough understanding of basic scientific principles, allows for

creativity and the formation of new solutions to problems not previously encountered.^{13,14}

Despite its importance, critical thinking remains a challenge to assess. Though cross-sectional studies have examined how novices compare to experts in solving clinical problems,¹⁵ the literature has not described the developmental milestones that a learner achieves in becoming an accomplished thinker.¹⁶ Many of the tools widely used to measure critical thinking are insufficient to assess it in a clinical context¹⁷; moreover, these tools have not established standards for how learners think and behave as they gain proficiency in critical thinking. One can no longer assume that a learner's ability to think critically will develop naturally through observation of more senior clinicians; it must instead be taught and explicitly assessed. Specific assessment will ensure that struggling learners are identified and supported with educational interventions to develop critical thinking skills.

The goal of our work was to delineate milestones through which an individual learner in medicine or nursing may progress during the course of training

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and in practice, so as to better characterize the competency of critical thinking. We hope to promote further dialogue and provide a foundation on which to base the creation of resources for educators and to establish expectations for learners.

The Process of Developing Milestones for Critical Thinking

Nine teams of health professions educators representing 17 medical and nursing schools were selected to participate in a conference on critical thinking through an application process described in detail in a separate paper.¹⁸ The goals of the conference were to explore approaches to teaching critical thinking and to develop strategies for integrating principles of critical thinking more explicitly into the curricula across the continuum of medical and nursing education.

A subset of conference participants, who were medical and nursing education leaders with responsibilities at the undergraduate, graduate, and continuing education levels, volunteered at the end of the conference to serve on a task force to continue work in this area. The group was charged by the conference organizers to define stages (i.e., developmental milestones) of critical thinking for medicine and nursing across the continuum. The group met by conference call for one hour semimonthly from December 2011 to September 2012.

The task force reviewed and considered competency models within and outside of the medicine and nursing literature. Building on the conceptual framework first established by the Foundation for Critical Thinking,¹⁹ the milestones for critical thinking articulated here were also heavily influenced by the Dreyfus model of the stages of expertise,²⁰ which has been applied extensively in nursing²¹ and in medicine.¹⁶ The language used in specialty board guidelines was an additional resource for creating the description of the milestones.^{22,23} Finally, looking beyond the health professions literature, the group considered Kegan’s²⁴ model of identity development, which acknowledges that individuals can be in transition between stages of development.

Importantly, the task force achieved consensus on a number of fundamental points. Milestones do not lock a person into a single developmental state.

Critical thinkers at any stage may regress under certain circumstances, such as confronting a demanding workload with sleep loss and fatigue, or emotional exhaustion brought about by personal problems. Competence in critical thinking is not automatically gained with increasing level of training or by competence in other domains. One cannot assume that clinicians with years in practice are accomplished critical thinkers; conversely, undergraduate nursing or medical students may already be highly developed critical thinkers.

After reviewing these frameworks, the task force created a matrix of attributes for each stage of critical thinking. The attributes were classified as “metacognitive abilities” (the ability to think about thinking), “attitudes” (dispositions towards critical thinking), and “skills” (referring primarily to cognitive skills). The group used an iterative consensus-building process to finalize the matrix. Finally, the group prepared an illustrative example to demonstrate how a teacher may use the matrix to identify a learner’s stage of developing competency in critical thinking.

The Stages of Critical Thinking

The milestones in developing competency in critical thinking correspond to six stages of thinking.

Stage 1: Unreflective thinker

Metacognition. The unreflective thinker does not demonstrate the ability to examine his own actions and cognitive processes. Lacking knowledge about cognition, he is unaware of different approaches to thinking and cannot examine either his own or others’ cognitive processes.

Attitudes. A lack of flexibility in the unreflective thinker’s thinking is manifested in his fixation on current working beliefs. He is unable to accept ambiguity or incorporate or adapt to new knowledge. Feedback that challenges his approach to reasoning is frequently met with a lack of insight.

Skills. He has a single approach to gathering and processing information based on crude scripts (e.g., rote memorization).

Stage 2: Beginning critical thinker

Metacognition. As a learner begins to think critically, she becomes aware of different approaches to thinking and starts to recognize cognitive differences in others. She requires external motivation to sustain reflection on her own thought processes.

Attitudes. Although receptive to feedback from others about her thinking, she rarely solicits it herself.

Skills. A beginning critical thinker sporadically uses different approaches to thinking and is able to gather information in a focused manner. The use of a limited number of approaches may lead her to arrive at incorrect conclusions or to include only the most likely explanations for observed phenomena. She recognizes the relevance of foundational principles related to decision making but, disconnecting theory from practice, does not apply them in action.

Stage 3: Practicing critical thinker

Metacognition. At this stage, the learner is familiar with metacognitive theories and applies conscious effort in his own critical thinking.

Attitudes. He demonstrates humility in acknowledging uncertainties, is open to challenges about his own thinking, and welcomes new approaches.

Skills. A practicing critical thinker can articulate multiple approaches to problem solving and use established principles to make sense of observations and guide decisions.

Stage 4: Advanced critical thinker

Metacognition. An advanced critical thinker has a solid repertoire of approaches to thinking and is able to identify the ways in which her own cognitive approach differs from others’. She consciously performs critical thinking and recognizes it as important and satisfying. She is adept at self-regulation and habitually seeks to overcome her gaps.

Attitudes. She actively solicits and accepts feedback and demonstrates a natural curiosity about alternative approaches to thinking.

Skills. She uses intuitive and analytical strategies interchangeably to solve problems, adjusts her thinking as is

appropriate to the context, and avoids cognitive biases. She explicitly bases her thinking and approach to problem solving on, and makes them congruent with, fundamental principles and concepts.

Stage 5: Accomplished critical thinker

Metacognition. An accomplished critical thinker uses theories of metacognition to enhance his understanding and conceptualization of problems. At this stage, he takes charge of his thinking and habitually monitors, revises, and rethinks approaches for continual improvement of his cognitive strategies.

Attitudes. He strives to advance not only his own but also others' approaches to thinking and openly acknowledges his assumptions and biases. He embraces uncertainty as a means to further understanding, goes beyond accepted "best thinking practices," and is creative and innovative in approaches to solving problems.

Skills. An accomplished critical thinker models critical thinking to others and demonstrates the ability to "toggle" adeptly between analytical and intuitive approaches. He elaborates complex connections between basic principles to create plausible hypotheses to explain observed phenomena. He has the ability to create new knowledge or understanding by reasoning inductively in this way.

A devolved state: The challenged thinker

External forces may precipitate a devolved stage of thinking; examples include an emotionally taxing situation (e.g., family illness or a complex, novel and intricate situation), a disproportionate value placed on personal priorities (e.g., the desire to succeed), or threats to individual identity (e.g., encounters with prejudice based on gender or race). A challenged thinker differs from a beginning critical thinker in that, while the latter operates in ignorance, the former is in a state of resistance (conscious or subconscious) to what she already knows about critical thinking and problem solving. This state is viewed as temporary; with resolution of internal or external stressors, the challenged thinker returns to her typical stage of critical thinking.

Metacognition. The challenged thinker resists considering others' perspectives, flouting prior knowledge of metacognition, and fails to recognize her own personal cognitive biases.

Attitudes. She is unwilling to reflect upon her own thoughts and approaches to problem solving and demonstrates intellectual conceit in justifying her own decision making.

Skills. She is firmly entrenched in a singular approach to thinking about the current problem and does not adjust when it would be appropriate to do so or when there are aspects of the problem that do not exactly fit the clinical situation.

An illustrative example

Appendix 1 displays responses to the clinical scenario requiring diagnostic reasoning from individuals at different stages of critical thinking. The task at hand focuses on the experience of a physician trainee, but is relevant across the spectrum of learners in both nursing and medicine. Keep in mind that milestones may manifest differently depending on the context within which critical thinking is applied. For example, early learners such as preclinical medical students and prelicensure nursing students may demonstrate critical thinking skills while conducting comprehensive patient assessment (taking a patient history or conducting a physical examination), whereas more advanced learners may reach a milestone while creating a differential diagnosis or management plan. Although the contexts differ by the specific learner's professional role, the stages of critical thinking development remain the same.

Discussion

Because it underlies performance in other competency domains, critical thinking can be considered a "meta-competency," or a set of attributes that are necessary for one to attain mastery across multiple competency domains.²⁵ Competence in critical thinking underlies the "entrustable professional activities" for health professionals, which define their ability to effectively care for patients without supervision.²⁶ We have identified milestones in critical thinking using an iterative, consensus-based process, to prompt consideration of strategies to both teach and assess the development of this skill for learners in the health professions. The milestones were created with the recognition that the development of this competency is independent of one's level of training,

although advanced knowledge and experience are likely to be associated with higher levels of critical thinking.

The example we provide to demonstrate how critical thinking stages are discerned among learners is intended to illustrate, in a concrete and specific way, how the milestones may apply in a given clinical situation; in particular, a diagnostic task. Not only can the milestones in critical thinking apply to other clinical skills, such as comprehensive assessment or management of a patient, but they can also be used outside of the patient care context to address the research, translational, and basic science problems that nurses and physicians encounter.

Critical thinking includes attitudes, such as self-awareness, the ability to self-reflect, and curiosity, which can be difficult to measure. It also entails the humility to admit when one does not have enough information or understanding to make a decision, which can be especially challenging for senior clinicians in the face of hierarchical dynamics between learners and teachers in the health professions. Though difficult to measure, attitudes of learners (and of teachers) will be essential to promote a culture in which having a thoughtful, systematic approach to problem solving is as important as having the "right answer."

We made some important assumptions in creating the milestones. Not all thinking should be considered critical thinking; excess reliance on intuitive, automatic thinking⁸ is characteristic of an "unreflective thinker" in this framework. Secondly, just as research related to problem solving is confounded by context specificity,²⁷ the ability to identify a learner's specific developmental stage in critical thinking also depends on the setting in which this competency is being measured. Thus, the use of milestones will require assessment across a variety of contexts to identify a learner's stage of competency in critical thinking.²⁸ We did not directly address the distinctions between hypothetico-deductive and inductive reasoning or the relative advantages and problems associated with each; our final model incorporates elements of both. Additionally, teachers must consider the various activities in which health professionals engage, such as conducting research and other

scholarly work, participating in public policy and advocacy, and educating patients, colleagues, and learners. Lastly, although content expertise and critical thinking expertise may correlate, the command of knowledge typical of master clinicians should not be conflated with the ability to rationally solve problems.

The premises under which we developed these milestones also present some limitations to their use. The milestones related to critical thinking are conceptual and must largely be inferred from observable behaviors; direct measurement of thinking processes is not always feasible. The milestones were deliberately written to be applicable to any setting but, as noted above, additional refinement will be needed to ensure applicability to the full range of contexts in which health professionals learn and practice. Secondly, although stage theories are linear and reductionist by definition, in reality, individual differences are marked,²⁹ and it is likely that some may be able to skip stages, demonstrate attributes from more than one stage at any given time, or find various pathways to reach the stage of an accomplished thinker. The members of the development task force, while all educators and leaders in medical and nursing education, participated and contributed to the discussions and decisions related to the matrix; however, consensus was not formally taken. Furthermore, the task force's conclusions may not represent opinions that are generalizable to the community of nursing and physician educators at large.

This work is meant to stimulate further dialogue and open up possibilities for further work. Designing assessment tools for critical thinking based on these milestones is a natural next step that would allow us to test them against other measures currently used to determine a learner's skill in thinking critically (e.g., global evaluation of decision-making skills and scores related to performance in practice-based learning and improvement). Though less frequently used in the health professions, published inventories of critical thinking could also serve as another source of validation of milestones-based tools.³⁰

Conclusion

We submit that milestones are necessary to facilitate the development of specific strategies to both teach and assess learner performance. Critical thinking transcends all other domains integral to the responsibilities and tasks of health care providers and has the potential to impact patient care outcomes. Therefore, the ability to identify a learner's challenges and guide them in the development of this vital competency must be a focus of more attention for educators in nursing and medicine.

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Appendix 1

Milestones of Critical Thinking Illustrated by Hypothetical Learners' Responses to a Clinical Scenario^a

Clinical scenario: Leah MacDonald, a 16-year-old high school student, has enjoyed good health. She is in clinic with her mother. This morning she noticed a sudden sharp pain in her abdomen that has been getting worse, keeping her from eating breakfast and going to school. She denies injury or any pain like this before. The pain is present all over her abdomen but is worse in the right lower quadrant. She has mild nausea but no vomiting or diarrhea. She was initially afraid to tell her mother about the pain because she was worried it might be related to a recent sexual encounter.

Stage	Learner Assessment
Learner as unreflective thinker	"This sounds like appendicitis. The patient is young, her pain is in the region of the appendix, and she has some associated intestinal symptoms. She will probably need a CT scan."
Interpretation of learner's explanation	The learner jumps immediately to the most obvious diagnosis and does not present a broader differential.
Attributes contributing to the assessment	<i>Metacognition:</i> The learner seems unaware of the possible fallibility in the diagnostic process and fails to acknowledge a systematic (or alternative) approach to assessing abdominal pain. <i>Attitudes:</i> The tone of certainty signals a close-mindedness to entertain other possibilities. <i>Skills:</i> The thinking is reflexive in that an imaging test is a first action without justification of this decision. The learner selects the features that are consistent with a "textbook" description of a disease presentation and neglects both context and facts that may suggest other possibilities (e.g., sexual activity).
Learner as beginning critical thinker	"This presentation seems typical for appendicitis, but a colleague of mine just took care of a patient with ovarian torsion who presented just like this patient. I wonder also if it could be ovarian torsion."
Interpretation of learner's explanation	The learner poses a limited differential that inadequately accounts for other possibilities.
Attributes contributing to the assessment	<i>Metacognition:</i> The inclusion of other thinking approaches focuses on the differential diagnosis, rather than the thinking process itself. The learner acknowledges the value of other approaches and recognizes diagnostic uncertainty by considering another clinician's experience. <i>Attitudes:</i> The learner is receptive to the input of others, but in a reactive way; he or she is willing to accept another clinician's conclusion without an examination of the evidence that might support or refute other possibilities for the diagnosis. <i>Skills:</i> The beginning thinker is at risk for being unduly influenced (being biased), in this case, "availability bias," being influenced by his or her own recent experience.
Learner as practicing critical thinker	"This patient is a healthy, sexually active teenager with acute right lower quadrant pain. Though this presentation could be consistent with appendicitis as a common condition in young patients, I need to consider other organs in the lower quadrants, such as gynecologic and renal etiologies. I also need to consider the developmental stage of this patient, her social and sexual history. Another approach to workup would be to prioritize action by ruling out "can't miss" diagnoses, which includes appendicitis, but also psychosocial concerns, ectopic pregnancy, PID, and ovarian torsion. Furthermore, questions from my preceptor remind me to consider the possibility of inflammatory bowel disease."
Interpretation of learner's explanation	In contrast to the earlier stages, the differential is much broader and reasoned with an anatomic or psychosocial justification for the inclusion of additional diagnoses. However, the learner does not consistently evaluate the merit of each.
Attributes contributing to the assessment	<i>Metacognition:</i> Although the learner considers various diagnoses, the strategies used to arrive at each, do not lead to a conclusion about which possibilities are most likely. <i>Attitudes:</i> The practicing critical thinker demonstrates two important attributes: openness to (not just an acknowledgment of) alternate diagnoses, as well as openness to prompting from a teacher to consider other possibilities. <i>Skills:</i> This is the first level at which the language includes semantic richness ¹⁰ referring to concepts that convey a deeper level of processing of the information ("healthy teenager" instead of "16-year-old female without past medical history").

(Appendix Continues)

Appendix 1

(Continued)

Stage	Learner Assessment
Learner as advanced critical thinker	<p>"In this case, the patient is worried about a sexually transmitted infection, which may cloud our thinking. The sexual history requires us to consider possible ectopic pregnancy in addition to infection, although if she had a period recently this might be less likely. However, in the right lower quadrant one also must think about the anatomy and appendicitis is a possibility. I should also consider other rarer conditions such as ovarian torsion, renal colic, endometriosis, and inflammatory bowel disease. An ultrasound examination will help clarify whether there are any masses in the right lower quadrant and blood work would help me to assess for infection and pregnancy. Is there anything else I should consider here?"</p>
Interpretation of learner's explanation	<p>The approach to assessment and the differential are broader than those considered at earlier stages. But it is not the length that distinguishes it; the learner rationalizes the differential as it is built, and considers more than one strategy to problem solving (e.g., anatomic approach, timing, and classic associations),</p>
Attributes contributing to the assessment	<p><i>Metacognition:</i> This individual understands the fundamentals of thinking about one's own mental processes in acknowledging the risk of being biased.</p> <p><i>Attitudes:</i> The thinker acknowledges the need to be open to as-yet-unseen alternatives.</p> <p><i>Skills:</i> The individual at this stage is reminded to "think about my thinking" and consider the possibility of cognitive biases and their potential impact on this clinical scenario. The advanced critical thinker also weighs appropriate next steps and justifies them logically. Finally, active engagement in continuous improvement is demonstrated by soliciting feedback about one's own thinking.</p>
Learner as accomplished critical thinker	<p>"This scenario presents several areas of ambiguity, which makes it rich as a learning and thinking case. How do I approach abdominal pain? The pain is 'sharp,' suggesting irritation of the peritoneum or the serosal capsule of an organ, rather than 'crampy' or 'colicky,' which would point to peristalsis of a muscular tube against an obstruction. The location of the pain in the right lower quadrant would then implicate a source of inflammation or irritation related to the intestines in the region of the ileum (e.g., ileitis due to inflammatory bowel disease or appendicitis), the ovary (e.g., ovarian torsion), or the Fallopian tube (e.g., pelvic inflammatory disease or a rupture due to an ectopic pregnancy). As I continue to weigh these options, I am aware of factors that may bias my thinking: the prevalence of a given condition and the patient's desire to keep her sexual history confidential. I want to be sure to consider possibilities that require urgent surgery carefully, but without putting undue emphasis on a rare diagnosis just because I may have encountered it recently. A quick literature review may help me to adjust and prioritize my differential while increasing my consideration of additional diagnoses. An ultrasound to look for ectopic pregnancy or ovarian torsion may be a starting point for ruling out urgent conditions, but I do need to conduct a risk analysis knowing the reliability of the ultrasound and the likelihood of various conditions."</p>
Interpretation of learner's explanation	<p>The learner does not depend upon recall of facts pertaining to the solution of the problem and avoids many of the cognitive biases associated with the hypothetico-deductive process (e.g., recall bias, early closure).</p>
Attributes contributing to the assessment	<p><i>Metacognition:</i> The accomplished critical thinker regularly and adeptly self-reflects and verbalizes a running commentary in parallel with clinical discussion (reflection in action). The accomplished critical thinker has a working familiarity with principles of metacognition and common cognitive biases and toggles naturally between intuitive and analytical approaches. The accomplished critical thinker acknowledges possible deficiencies in the thinking processes (i.e., cognitive biases) and thereby exemplifies the skill of self-regulation.</p> <p><i>Attitudes:</i> In being willing to seek out additional information from the literature, the accomplished critical thinker displays an attitude of intellectual humility.</p> <p><i>Skills:</i> The accomplished critical thinker may reason inductively from basic principles and, when appropriate, creates new solutions for problems not previously encountered. The individual extends the thinking processes to propose a course of action that is not only consistent with one approach (prioritizing urgency) but also includes probabilistic thinking.</p>
Learner as challenged thinker	<p>"Clearly this is a case of either ectopic pregnancy or PID. She is obviously concerned about her sexual contact and we should start with a pregnancy test and a pelvic exam. I've been working in an STD clinic and have seen many cases just like it. We must make sure her mother is not in the room. And this is sure to put us behind in the clinic."</p>
Interpretation of learner's explanation	<p>The learner uses premature closure similar to the unreflective thinker and does not admit to any biases. Environmental factors influence the depth of the response.</p>
Attributes contributing to the assessment	<p><i>Metacognition:</i> Time constraints lead the challenged thinker to disregard any prior knowledge of metacognition.</p> <p><i>Attitudes:</i> The challenged thinker is overconfident in reaching conclusions without being aware of the thinking process and is unaccepting of guidance.</p> <p><i>Skills:</i> Letting anxiety and time pressures unduly affect his or her thinking, the challenged thinker adopts a singular approach to thinking.</p>

^aThe case scenario, hypothetical learners' responses, and analysis of the learners' responses were developed and refined by the members of the Task Force on Critical Thinking to illustrate learners at different milestones of critical thinking.