ISSN: 2641-2020
DOI: 10.33552/APPR.2026.05.000607
Archives of
Pharmacy & Pharmacology Research
Iris Publishers

Opinion

Vetting the Algorithm: Critical Thinking as a Core Competency in the Age of GenAI-Assisted Pharmacy Practice and Education

Thomas A Mennella[1*]

Department of Physical and Biological Sciences, Western New England University, USA

***Corresponding author:** Thomas A Mennella, Department of Physical and Biological Sciences, Western New England University, USA

Received Date: May 06, 2026

Published Date: May 13, 2026

Abstract

The term "critical thinking" appears in pharmacy program accreditation standards, institutional mission statements, and faculty syllabi with such frequency that its meaning has become diluted. At its core, critical thinking is the capacity to get, vet, and use new knowledge and it is built, as Bloom's Taxonomy makes clear, on a foundation of genuine understanding rather than rote memorization. That foundation is precisely what much of K12 education fails to provide, leaving incoming pharmacy students ill-equipped to develop the higher-order skills their profession demands. The problem has become urgent. Since the release of ChatGPT, GenAI adoption has been unprecedented in speed and scope. By mid-2026, GenAI outputs are largely accurate, contextually relevant and professionally polished, and occasionally dangerously wrong. The ability to distinguish between the two is not an AI literacy skill. It is a critical thinking skill. As automated systems absorb the procedural elements of pharmacy practice, the pharmacist's most irreplaceable function will be exactly that: evaluating, verifying, and taking professional responsibility for outputs that no algorithm can currently be trusted to self-correct.

This opinion piece argues that direct-entry Doctor of Pharmacy programs are uniquely positioned to address this gap. Their extended curricula, motivated student populations, and professional accreditation structures make them ideal testing grounds for a pedagogy that deliberately rebuilds the learning foundation K12 left incomplete for many students. Specific strategies - including explicit instruction in Bloom's Taxonomy, deemphasis of memorization in early years, active learning frameworks, and structured GenAI integration in later years - are proposed. The goal is not GenAI fluency. It is teaching future pharmacists to think alongside GenAI: leveraging its strengths, guarding against its failures, and bearing professional responsibility for the difference.

Keywords: Critical Thinking; GenAI; Bloom's taxonomy; active learning

Abbreviations: GenAI: Generative Artificial Intelligence

Introduction

Ask ten stakeholders in higher education - instructors, administrators, staff, students, families or board members - to name the top five outcomes that are essential from a college education, and I suspect that at least eight of them would include *critical thinking* on their list. Indeed, the Accreditation Standards and Key Elements for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree (established by the Accreditation Council for Pharmacy Education), have critical thinking explicitly named as a required skill in Standard 2.1.b while critical evaluation and analysis are also mentioned [1]. However, the term "critical thinking" is now tossed around so liberally that I believe many of us have lost sight of what it means. The Foundation for Critical Thinking defines it as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluat-

ing information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action" [2]. In other words, it is understanding something, validating its authenticity, integrating it into the learner's base knowledge, and then using it for future decision making. Simpler still, critical thinking is: getting, vetting, and then using new knowledge.

It is no coincidence that Bloom's Taxonomy is so deeply integrated into the definition of critical thinking [3]. Essentially, "critical thinking" serves as a catch-all, umbrella term for the upper level of Bloom's. Those upper levels are supported and made possible by the lower, foundational levels of Bloom's Taxonomy: remembering and understanding. A new learner must first learn (i.e., *remember*) the facts and terminology of a discipline, and then *understand* how those facts connect into a story. This provides the foundation on which critical thinking can then be built. And make no mistake: core knowledge is composed of stories. Whether it is mitosis, the lac operon, Michaelis-Menten enzyme kinetics or the inhibition of HMG-CoA reductase by statins [4], these are stories to be *understood* featuring characters with unfamiliar names that must be *remembered* (i.e., memorized).

Unfortunately, as the father of two young adults [5], both recent high school graduates from a highly ranked school district in one of the strongest states in the US for public education (Massachusetts), I have seen firsthand what K12 education prioritizes. Much of K12 education (especially in the sciences) emphasizes and assesses memorization, at the expense of understanding [6,7]. This creates a significant potential break in the chain towards gaining critical thinking skills. Without understanding, application, analysis, synthesis and evaluation become untenable, undermining the very critical thinking skills that we are trying to foster.

Since the release of ChatGPT by OpenAI in November 2022, the adoption of Generative AI (GenAI) tools by individuals and the job sector has been unprecedented. Within two months of its release, ChatGPT amassed a user base of 100 million active monthly users, with an average of 13 million unique daily users throughout the month of January 2023 [8]. This rate of adoption dwarfed that of other mega-online services up until that point in time. For example, TikTok and Instagram required nine months and two and a half years, respectively, to reach 100 million unique users [8]. By mid-2026, as I sit and write this, GenAI hallucinations are minimal and uncommon, GenAI outputs are contextually relevant and largely factually correct, and GenAI writing is typically well polished (if, admittedly, verbose and sycophantic). In my opinion, writing skills (i.e., the ability to write well and clearly) will be largely unnecessary within five years. Instead, the most essential "writing" skill required by tomorrow's professional workforce will be the assessment and validation of the accuracy and efficacy of GenAI written outputs. In other words, the ability to 'actively and skillfully conceptualize, apply, analyze, synthesize, and/or evaluate information gathered from…' GenAI '… as a guide to belief and action.' Critical thinking has never mattered more than it does right now.

Discussion

GenAI is here to stay, it is usually correct in its outputs, but occasionally very wrong, and critical thinking skills are the most essential for telling the difference. Additionally, we've established that critical thinking skills must be built on a foundation of remembering and understanding. Therefore, we have a problem. Many high school graduates enter college with little intrinsic curiosity, minimal training in seeking understanding, and feeling unprepared for adulthood [9]. This is the antithesis of being primed to develop critical thinking skills. However, in this current landscape, direct entry Doctor of Pharmacy programs may be the best poised to pilot interventions designed to bridge the gap between K12 instilled memorization strategies and post-graduate critical thinking skills. Such programs accept recent high school graduates into accelerated programs that culminate, usually six to eight years later, in a terminal degree. That's ample time to recalibrate students' notion of learning and then build the skills that support genuine learning via Bloom's. Furthermore, such programs ostensibly have more motivated and invested students with some certainty of their vocation and dedication to successful learning. Thus, reparations of misguided K12 learning strategies can be intentionally embedded into the early curriculum to foster genuine inquiry and understanding, while GenAI can be integrated into later curricular components as an ongoing test case of validation and vetting. The goal should be to teach students to be skeptical, to doubt, to verify and to think critically.

As an example, early in Year 1, share Bloom's Taxonomy with students. Make it clear that memorization is not learning, it is merely the first step of learning. Deemphasize memorization by allowing students to have terminology notecards for exams in early years (they will be able to look the terms up when needed on the job anyway). Focus on the *stories* of the concepts, not the characters. Incorporate active learning whenever possible. This can be done by freeing up class time using strategies such as flipped learning or mastery-based instruction and then using that time for in-class activities that foster critical thinking. To that end, use "think-pair-share" widely and often. This technique, developed by Professor Frank Lyman and his colleagues at the University of Maryland in 1981, is the embodiment of critical thinking. Students are given a challenging question or problem, given time to work through it alone (think), then asked to connect with a neighbor (pair) and share their tentative answer (share). Students are encouraged to both advocate for their answer while also listening closely and deeply to their partner's advocacy for their own. Together, student-pairs arrive at an ideal, consensus answer that they are both satisfied with and then the class debriefs. This is critical thinking in action.

In later years, begin incorporating GenAI into class activities as the think-pair-share partner. Have students maintain a log or journal across classes of GenAI's accuracy and establish a program-wide "Hall of Shame" for GenAI's biggest and most dangerous blunders. This will serve as an on-going lesson of the risks of trusting these tools too widely and implicitly. Most essentially, assess critical thinking regularly and often throughout the curriculum. Heather Butler has a wonderful analysis of many different, widely used and vetted critical thinking assessment instruments [10]. Finally, be sure to close the assessment loop by revising the curriculum and improving critical thinking outcomes iteratively.

Curricular reforms of this kind aren't radical. They are, in fact, simply a long-overdue alignment between what Bloom's Taxonomy has always told us about learning and what GenAI now demands of graduates. The reforms I am suggesting should focus on minimizing memorization and emphasizing understanding. With a solid foundation in understanding - and as students become accustomed to the *feeling* of learning - later years can move on towards building genuine critical thinking skills. Application, analysis and evaluation have always been the keystone - the apex - of learning and never has this been more important than now when critical thinking skills are at a premium.

Conclusion

While most other professions are either highly exposed to GenAI or relatively safe from exposure, the job of a pharmacist lies at a unique intersection of what GenAI can do well and what it can't. With digital medical records, networked data connections between clinics and pharmacies, and automated medication dispensers, much of the hands-on work of a pharmacist will soon likely be outsourced to AI and other automated systems. The daily drudgery of dispensing medication will be handled by the bots. The role of the pharmacist will likely shift to that of, for lack of a better term, "fact-checker". I don't mind GenAI putting my pills in a bottle, but I want a pharmacist signing off before I'm handed the bag. Ensuring that the correct medications were dispensed in the right dosage to the right patient with minimal risk of drug interactions will be the job. In other words, most of the role of a pharmacist will be that of a *critical thinker*.

Pharmacists must be taught - from Year 1 to Year 6 or 8 - that GenAI is synonymous with an online blog, a knowledgeable patient, or a well-intentioned neighbour. In other words, reserve trust until verified. The journal of AI errors and Hall of Shame recommended above embody the core of the post-GenAI curriculum: GenAI outputs must be treated by students and practicing pharmacists the way they treat any unverified clinical source - with structured skepticism as a professional obligation. In other words, considered with a full array of critical thinking skills. The most GenAI-aligned curricula in pharmacy programs and, indeed, throughout all higher education will not be those that teach AI fluency, prompt engineering, or the suite of tools and platforms available. Instead, it will be the curricula that teach students how to *think* alongside GenAI. How to leverage its strengths, guard against its shortcomings, and recognize the difference between the two. The foundation for this is genuine learning. The structure built upon that foundation is critical thinking. GenAI is simply the latest - and most compelling - reason to get both right.

Acknowledgement

None.

Conflict of Interest

No conflict of interest.

References

1. Accreditation Standards and Key Elements for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree, Accreditation Council for Pharmacy Education.
2. Defining Critical Thinking. The Foundation for Critical Thinking.
3. Bloom B (1956) Bloom's taxonomy.
4. Istvan E (2003) Statin inhibition of HMG-CoA reductase: a 3-dimensional view. Atherosclerosis Supplements 4(1): 3-8.
5. Education Rankings. US News & World Report.
6. Hancock ES, Gallard AJ (2004) Preservice science teachers' beliefs about teaching and learning: The influence of K-12 field experiences. Journal of Science Teacher Education 15(4): 281-291.
7. Porter JR (2014) An Investigation in the Use of Memorizing as a Learning Method When Teaching Measurement in a Technology Education Classroom.
8. Hu K (2023) ChatGPT sets record for fastest-growing user base.
9. (2025) Post-Graduation Readiness Report. YouScience.
10. Butler HA (2024) Predicting everyday critical thinking: A review of critical thinking assessments. Journal of Intelligence 12(2): 16.