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A Framework for Enhancing Critical Thinking Within Health Science Courses

Tim Brackenbury

Mary-Jon Ludy
Bowling Green State University, mludy@bgsu.edu

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Tim Brackenbury, Ph.D., CCC-SLP & Mary-Jon Ludy, Ph.D., RD

Bowling Green State University

Description of the Teaching/Learning Context

Critical thinking is a cognitive act that applies analysis and reasoning to answer complex questions and guide decision-making (Dwyer, Hogan, & Stewart, 2014). It is an important skill to address in the classroom, but instructors can find themselves at a loss for best practices (Folkins, 2016; Halx & Reybold, 2005; Nicholas & Raider-Roth, 2011, 2016). This chapter provides an evidence-based framework for enhancing college students' critical thinking skills across health disciplines.

Critical thinking is an essential component of clinical practice in the health professions (Huang, Newman, & Schwartzstein, 2014; Sharples et al., 2017). Providers must draw upon the body of evidence-based literature to guide patients and the interdisciplinary medical team to make informed health decisions. Critical thinking skills can reduce the frequency of diagnostic and management errors that occur in patient care (Harasym, Tsai, & Hemmati, 2008). Among students in health disciplines, critical thinking skills are positively associated with academic success (Ross, Loeffler, Schipper, Vandermeer, & Allan, 2013).

The course, *FN 4400: Research Methods in Nutrition, Foods, and Dietetics*, at Bowling Green State University was recently redesigned to improve students' critical thinking skills and address their common concerns about research (see Earley, 2014). To do so, we developed an

evidence-based framework for teaching critical thinking and incorporated it into the FN 4400 course. The framework consists of the following four themes:

1. Critical thinking needs to be addressed in the design of courses and integrated throughout their activities and assignments.

2. Careful consideration and routine application are required for introducing students to critical thinking and motivating them to use it.

3. Instructors need to model the process of critical thinking, with an emphasis on how different conclusions can be reached and justified.

4. Assignments and assessments of students' critical thinking should allow space for risk taking and creativity.

Review of Extant Literature

There is a considerable literature on teaching critical thinking within disciplinary courses. The research consists primarily of experimental and quasi-experimental studies that examine changes in students' critical thinking skills before and after teaching experiences, typically in comparison to those of a control group. Outcome measures include standardized tests of critical thinking and tasks developed by educators and researchers. Health care professions, especially nursing, play a prominent role in this literature.

Meta-analyses and systematic reviews have shown reliable, positive effects of teaching critical thinking within college courses (e.g., Abrami et al., 2015; Tiruneh, Verbugh, & Elen, 2014). Harris and Welch Bacon's (2019) review of 154 studies in health care professions, for example, identified improvements in critical thinking, problem-solving, and/or decision-making in 84% of investigations that used active-learning methods. The results from studies examining specific teaching methods, however, have varied. Two approaches that have shown particular

promise and are highly relevant to critical thinking within health professions are problem-based learning (PBL) and evidence-based teaching (EBT).

PBL is a learner-centered approach that promotes student inquiry through efforts that address complex, real-world issues (e.g., Savery, 2006). As the first step in PBL, students are presented with multifaceted problems in order to motivate understanding and application of the course objectives and content (Hung, 2009). The problems can include case studies, ethical dilemmas, simulations, and role-playing (Abrami et al., 2015). Instructors in PBL serve as facilitators and tutors, guiding students through stimulating questions, providing "just-in-time" feedback, and delivering encouragement. Developed from medical science education, PBL addresses critical thinking skills through student collaborations that analyze problems and their origins, evaluate potential solutions, and create defensible plans of action. Most of the studies identified across systematic reviews and meta-analyses reveal significant improvements in critical thinking skills following PBL (Carvalho et al., 2017; Harris & Welch Bacon, 2019; Kowalczyk, 2011; Tiruneh et al., 2014).

EBT is an educational offshoot of evidence-based medicine/practice. It focuses on the knowledge and skills for incorporating research literature, clinician expertise, and client values to address educational and professional issues. EBT incorporates PBL by presenting students with perplexing clinical cases that are not easily solvable, such as determining the optimal course of treatment for an atypical patient or addressing a controversy within the field. EBT connects with critical thinking through activities such as finding and evaluating evidence, examining one's own experiences and biases, and collecting and incorporating clients' opinions (Petty, 2009; Schwartz & Gurung, 2012). Cui, Li, Geng, Zhang, and Jin (2018) reviewed nine studies that examined "evidence-based nursing," a form of EBT. Significant improvements in overall critical thinking

and its subdomains (e.g., inferences, interpretations, and truth-seeking) were reported among students who received evidence-based nursing training compared to those who did not.

Along with individual approaches like PBL and EBT, there is evidence that combining approaches facilitates critical thinking development. Abrami et al. (2015), for example, found that "authentic instruction" (i.e., PBL) and classroom dialogue, but not direct mentorship, uniquely contributed to critical thinking development. Significantly higher effect sizes, however, were observed when authentic instruction was combined with dialogue, and when all three factors were intermixed. There are additional positive effects on students' critical thinking when teaching models address multiple components of thought and practice (e.g., Anderson & Reed, 2013; Ralston & Bays, 2015).

General strategies for teaching critical thinking have also been examined. These include whether critical thinking skills should be taught explicitly or implicitly, and if they should be addressed within the course content or as a separate unit. Abrami et al.'s (2015) analysis of effect sizes from 684 experimental studies on teaching critical thinking found significant individual positive effects for a) explicit instruction within the content, b) explicit instruction outside of the content, c) implicit critical thinking experiences within the content, and d) explicit separate instruction followed by implicit experiences (see also Ennis, 1989). No significant differences were observed between strategies, suggesting that instructors can use the strategy that best fits their experiences and circumstances.

Application of Extant Research to the Teaching/Learning Context

As a whole, the literature demonstrates that critical thinking can be effectively taught within disciplinary courses in the health professions. Using an evidence-based approach, we applied the research literature, our own teaching experiences and those of our colleagues, and

students' input to develop our critical thinking framework. This section provides details on the framework's four interactive components, as well as examples of how they were incorporated into the FN 4400 course.

1. Design and Integration

Component overview.

Critical thinking needs to be considered and incorporated throughout the design of the course. It should be an essential element of the experience, infused within the daily sessions, assignments, and assessments. This can be achieved by designing the class around a critical thinking-based theme that complements the topic of the course and aligns with students' interests in a manner that is clearly relevant to their future professional practice. Similarly, including critical thinking in the course goals clearly demonstrates its importance. The problem-solving nature of critical thinking, for example, can be incorporated into goals for improving students' understanding of foundational knowledge by applying important terms in meaningful contexts, abilities to analyze and evaluate different forms of evidence, and development of clinical reasoning and decision making skills.

FN 4400 application.

To motivate an early interest in the course and stimulate critical thinking about the importance of course content in the professional setting, an engaging syllabus is used (Ludy et al., 2016; the course syllabus may be viewed at https://tinyurl.com/FN4400Syllabus). This is distributed to students electronically prior to the first class. It includes pictures of students and faculty from the program who are engaged in research activities (e.g., conference presentation, laboratory-based data collection). To demonstrate relevance, learning objectives are explicitly linked to programmatic accreditation standards (Accreditation Council for Education in Nutrition

and Dietetics, 2017) and many required readings are from disciplinary journals (e.g., Byerley et al., 2017). In the upcoming academic year, readings from popular press books will also be incorporated (e.g., Hanna-Attisha, 2018; Skloot, 2010).

Throughout the course, junior- and senior-level research methods students conduct health assessments on first-year college students as part of an on-going research study that is linked with a learning community. Assessment variables include common health markers that are evaluated in clinical nutrition practice (e.g., blood pressure, body composition, cholesterol, fitness). Prior to conducting assessments on first-year students, research methods students receive training from and demonstrate proficiency to graduate students and faculty in nutrition and exercise science (Ludy, Tucker, Crum, & Young, 2016). Assessments are conducted twice during the semester. In addition to collecting the data, research methods students are involved in preliminary data analysis and communicating the results back to the first-year students in the learning community. The research methods students have responded favorably to this model of incorporating critical thinking into the course, as demonstrated by the following comment from a recent course evaluation:

> "The hands on approach within FN 4400 should stay the same. It was very beneficial to have that experience with the health study and I personally learned a lot from it. Having this experience helped me understand how to work with human subjects and learn from trial and error."

2. Routine Application

Component overview.

Students should be provided with repeated small and large activities that invite critical thinking as a routine part of the course experience. Our preference is to identify and define

critical thinking (i.e., applying analysis and reasoning to answer complex questions and guide decision-making) at the very start of the course and refer to it throughout the semester. This includes introducing and applying key terms and skills associated with critical thinking, such as assumptions, confirmation bias, value preferences, evidence, and self-reflection.

FN 4400 application.

The culminating assignment in the research methods course is preparation and review of a federal-style grant proposal. Instead of a single high-point value assignment, the grant proposal process is divided into multiple low-stakes assignments with regular feedback and numerous opportunities for revision. Students have seven low-stakes assignments related to grant writing, including developing research questions, identifying key references, summarizing the background literature, planning the methods, and justifying a budget. Each low-stakes submission includes revisions based on feedback from previous submissions. Likewise, after receiving feedback from the instructor and graduate assistants, students engage in a low-stakes peer critique prior to participating in a full federal-style grant panel review. A student commented that: "I loved how the grant proposal was broken up into sections each week. It made it simple and I was not overwhelmed. We had the right amount of time to work on each section."

3. Modeling the Process

Component overview.

Instructors are good at describing complex professional situations and the choices they would make. However, they do not always include the "behind the scenes" details about how the conclusion was determined, such as the other possibilities considered, why those were eliminated, additional information needed and how it was acquired, conclusions that other

professionals might choose, and deciding what to do when more than one conclusion appears to be appropriate.

FN 4400 application.

To reduce anxiety and nervousness about the process of receiving and responding to critical feedback, the instructor shares reviewer feedback from previous grant and manuscript submissions that demonstrate both imperfections and differing viewpoints. Additionally, past FN 4400 students voluntarily return to present their undergraduate research projects and share rough drafts of manuscripts that they plan to submit to peer-reviewed professional journals. Current FN 4400 students provide critical feedback to past students using guided prompts (e.g., concerning the scientific merit, clarity of goals and writing, discussion of findings in the context of previous literature, greatest strength, and single improvement that would have the greatest impact). This serves as a mutually beneficial process. Current students have the opportunity to learn peer review skills and build confidence in the process, subsequently using the same guided prompts to provide low-stakes reviews to their classmates. Past students model the process of accepting and integrating feedback prior to manuscript submission, ultimately being successful at having their manuscripts accepted for publication in professional journals (Lechner, Gill, Drees, Hamady, & Ludy, 2019; Traxler, Morgan, Kiss, & Ludy, 2020). Collectively, these activities provide students with a model for critically evaluating and discussing the work of their peers. A student commented that "it was super beneficial how we had so much feedback from each other, the professor, and older dietetics students."

4. Risk Taking and Creativity

Component overview.

Critical thinking in the classroom is a risky endeavor for many students. Not fully understanding the problem, misapplying information, making false assumptions, and giving a wrong answer can all be frustrating and embarrassing. Creating a classroom environment that allows for risk taking and creativity addresses these issues while demonstrating the process and power of critical thinking. Throughout this process, the instructor reinforces all of the ideas shared, accurate or inaccurate, as valuable steps in critical thinking. To maximize risk taking and creativity, few points or other negative consequences are associated with these activities.

FN 4400 application.

To encourage risk taking and creativity throughout the grant proposal process, students are assigned into small groups based on similar research interests and varied skillsets. Prior to group assignments, students complete a survey. They rank their research interests from a number of faculty areas of expertise (e.g., food insecurity or sports nutrition), so that if they decide to pursue undergraduate research opportunities they can find mentorship. They rank self-perceived skills including creativity, math, and writing. They also rank preferred group roles including people manager, project manager, and recorder. Each group has a common research interest and students were assigned primary responsibilities based on their self-perceived skills and preferred group roles. For example, one 3-member group had a shared interest in diabetes with assigned roles as math/recorder, creativity/people manager, and writing/project manager. The rationale is that students will be more likely to take risks because they know that group members have all the skills necessary to succeed, combined with multiple opportunities for revision (as described in the "Routine Application" section above). A student appreciated: "…the process put in place to form our groups for the Grant Proposal project. I feel that that worked well in forming groups of people with different strengths but similar interests." Another student liked: "… the way the

groups are assigned. I would have not picked the members that were in my group originally - but I would not change who I ended up with since we all worked evenly and well together." Two of the eight groups from the most recent course have gone on to pursue undergraduate research funding based on the grant topics they explored in FN 4400.

Application to Cross-Disciplinary Contexts

We have successfully applied this teaching critical thinking framework to a number of courses outside of FN 4400, and believe that it can be used in classes across health disciplines. This section contains general ideas for applying these in a cross-disciplinary context.

1. Design and Integration

Critical thinking and its related skills can be designed as themes that complement the course topic. Examples of such themes include *facing challenges*, *learning from oth*ers, *appreciating differences*, and *professional thinking*. Once a theme is identified, it should be integrated into the course goals, teaching and learning activities, and feedback and assessment. For example, a course designed around *appreciating differences* can include goals such as:

- You (the student) will identify and consider the points of view of different professions towards clinical assessment and intervention.

- You will incorporate clients' personal and cultural views in your intervention planning.

- You will identify your own preconceptions and how they can negatively influence your professional decisions.

Classroom activities focused on *appreciating differences* should emphasize the multiple ideas that relate to the problem and how they each contribute to a comprehensive understanding of the issue. Likewise, evaluations and feedback should focus on the process of identifying and considering different ideas in decision-making.

2. Routine Application

A simple way to build routine application into a course is to follow a similar structure for each unit. In some of our classes, for example, we follow principles of PBL by starting new units with a clinically relevant problem that is strongly connected to the topic and is ~ 80% solvable with the students' current knowledge and skills. After considering the issue, they identify what they know, what they would like to know, and multiple potential solutions. They turn to the course readings to address all three of these topics and submit reading worksheets describing the relevant information, the confusing information, and how both might help address the issue. The instructor leads small and large group classroom discussions that address these issues and introduce other relevant information. Assignments provide similar cases to be analyzed, to promote comparisons and generalization. Final conclusions to the original problem are developed, as well as compared and contrasted with each other and the initial solutions.

3. Modeling the Process

Storytelling of past clinical decision making is a common method for modeling critical thinking. This is useful but may not be as influential as directly demonstrating critical thinking in real-time along with the students. Engaging in critical thinking activities such as those described above changes the instructor's role from the course's source of knowledge to a fellow problem-solver. It is especially helpful if the instructor can step back from their preconceived solution and take on the mindset of a less experienced professional. As an active participant, the instructor shares their initial questions, collects and incorporates information from other sources, considers and learns from the students' ideas, and reaches reasonable conclusions. Doing so models the critical thinking process, demystifies clinical decision-making, debunks the notion of a "one-true correct response," and provides meaningful opportunities for EBT.

4. Risk taking and creativity

Working in small, in-class groups provides students with an intimate setting to brainstorm and work through their initial ideas. These can be shared in a non-threatening way by having each group write their initial conclusions, solutions, and rejected ideas on the board. The instructor leads a whole-class discussion comparing and contrasting the groups' ideas. Strong ideas are recognized and weak ideas are acknowledged for their contribution to better understanding. Near the end of the conversation, every student walks around the room and places a checkmark by the three ideas that they like the best overall. This facilitates a final discussion to plan the next steps. The advantage of a structure like this is that students get to share their ideas and be creative without fear of personal embarrassment or penalty for being incorrect.

Resources for Readers to Access Additional Research

Additional helpful resources for enhancing students' critical thinking skills include:

- a repository of books, research, and professional development opportunities:

  https://www.criticalthinking.org/.

- a process for designing a critical thinking-based course:

  https://www.thecriticalthinkinginitiative.org/.

- an overview of teaching critical thinking within health disciplines:

  Finn, P., Brundage, S. B., & DiLollo, A. (2016). Preparing our future helping

  professionals to become critical thinkers: A tutorial. *Perspectives of the ASHA Special

  Interest Groups SIG 10, 1*, 43-68.

- an integrated approach to designing college courses:

  Fink, L. D. (2013) Creating Significant Learning Experiences (2nd Edition). San

  Francisco, CA: Jossey-Bass.

- examples of how components of this framework connect with motivation and engagement principles from video game design:

  Folkins, J. W., Brackenbury, T., Kraus, M., & Haviland, A. (2016). Enhancing the therapy experience using principles of video game design. *American Journal of Speech-Language Pathology, 25*, 111-121.

- a discussion of how critical thinking fits within disciplinary teaching:

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