Literature Review

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Literature Review

Nursing faces a workforce crisis. Brought forth by COVID-19, nearly 250,000 nurses have left the profession since 2020. As a result, there is an urgent need to recruit, train, and graduate nurses in order to meet the needs of already overburdened local hospitals and health centers.

Academic attrition in nursing education is a key barrier to addressing the nursing shortfall facing hospitals and healthcare centers across the United States. Research has documented high attrition rates across studies and samples, ranging from 20% to 50% depending on the research study (Merkley, 2015; Tacy et al., 2023). While not all attrition is undesirable, the current rate of nursing school dropout makes it impossible for the nursing workforce to repopulate itself. As the United States Bureau of Labor Statistics (2025) notes, “employment for registered nurses is projected to grow 5% from 2024-2034” with approximately 189,100 new openings for registered nurses projected each year (2025, "Job Outlook" section).

The attrition rate for pre-service nurses (i.e., students in nursing programs) is compounded by the limited capacity that schools of nursing have for students wishing to enter the profession. For example, in 2023, an average of 20% of qualified applicants were rejected from nursing schools in the United States (National League for Nursing [NLN], 2023). Thus, students who leave nursing school without a diploma represent a double loss for the nursing profession’s workforce development needs: Not only do these students fail to enter the workforce, but they also limit the opportunity of students who might otherwise have been successful in nursing programs. Ultimately, every student who drops out of nursing programs is estimated to cost those programs nearly $10,000 per year in community colleges, and $21,000 per year in four-year universities (Montauban, 2025), and the National Center for Health

Workforce Analysis (2025) estimates a projected 8% shortage of Registered Nurses in 2028. These very tangible aspects of nursing student attrition should cause significant alarm in faculty and institutions and spur initiatives focused on retention.

Problem Context

When Student Attrition Occurs

Research indicates that attrition rates are often the most pronounced during the first year of nursing coursework. For Bachelor of Science programs, students begin their coursework during their sophomore year. For students in Associate Degree programs, most attrition occurs in the first year (Park et al., 2025). Typically, the courses offered early in a student's program of study include classes on Nursing Fundamentals, Basic Medical Surgical Nursing, and Pharmacology. These courses typically introduce and emphasize complex concepts and dense terminology, thereby challenging students' ability to make sense of, internalize, and later recall course content.

Pharmacology arguably presents the most pressing challenge because it requires an understanding of anatomy and physiology, microbiology, and the disease processes requiring medication intervention. These nexus of complex concepts and their interwoven aspects requires students to critically analyze and apply knowledge to unfamiliar and ever-changing patient conditions. Prochnow et al. (2022) report persistent deficits in the acquisition and retention of pharmacological knowledge among nursing students. Given that pharmacology is commonly taught during the first semester of nursing programs, improving student performance in this course may help address one of the academic challenges associated with early student attrition.

This concern is also locally relevant. In the nursing program that serves as the context for this improvement effort, pharmacology is one of the foundational first-semester courses students

must successfully complete. Because pharmacology requires students to learn, retain, and apply large amounts of unfamiliar information early in the program, student difficulty with this course may contribute to early academic struggles and program attrition. For this reason, pharmacology provides an appropriate local context for examining how instructional design can better support early nursing student success.

The purpose of this review is to examine the learning, instructional, and curriculum design factors that contribute to early academic difficulty and attrition in nursing education, with particular attention to pharmacology as a high-cognitive-load course commonly encountered during the first semester of nursing programs. Therefore, pharmacology can serve as a model for identifying some of the challenges associated with instructional and curriculum design methods that contribute to early academic difficulties.

First, this review identifies cognitive development or learning theories that describe how individuals process, organize, retain, and recall complex information. Next, this review identifies research related to self-regulation, metacognition, growth mindset, attributions, and academic resilience, which would assist in developing a greater understanding of the skills required by nursing students to be successful in high-cognitive-load nursing curricula. Finally, this review identifies instructional strategies that can help faculty members support their students in developing the skills necessary to succeed in high-cognitive-load learning environments.

This review argues that early nursing student attrition reflects three interconnected challenges. First, students encounter a learning problem because they often enter nursing programs without the competencies required to successfully learn, retain, and apply complex information. Second, nursing education faces an instructional problem because these competencies are frequently assumed rather than explicitly taught. Third, nursing programs face

a curriculum design problem when course structures do not systematically support the development of effective learning behaviors. Together, these challenges create barriers to success in high-cognitive-load courses, such as pharmacology, and contribute to early academic difficulties and attrition.

Improvement Science Lens

Improvement Science provides a framework for addressing complex problems in real-world settings. Unlike traditional research, which often focuses on determining whether an intervention works under controlled conditions, Improvement Science focuses on understanding how and why improvement occurs within a specific context. The goal is not simply to generate knowledge, but to use that knowledge to improve outcomes within an existing system (Bryk et al., 2015; Langley et al., 2009).

A central feature of Improvement Science is the use of a theory of change. Improvement efforts begin by identifying the factors believed to influence a desired outcome and then developing interventions that target those factors. One tool commonly used for this purpose is the driver diagram. Driver diagrams visually represent the relationship between an improvement aim and the primary and secondary drivers believed to influence that aim. In doing so, they help improvement teams organize existing knowledge, identify areas for intervention, and create a roadmap for change (Bryk et al., 2015).

Improvement Science evaluates theories of change through an iterative process known as Plan-Do-Study-Act (PDSA) cycles. Rather than implementing large-scale changes immediately, PDSA cycles encourage the testing of small changes to determine whether they produce the intended results. Data collected during each cycle are then used to refine, modify, or expand the

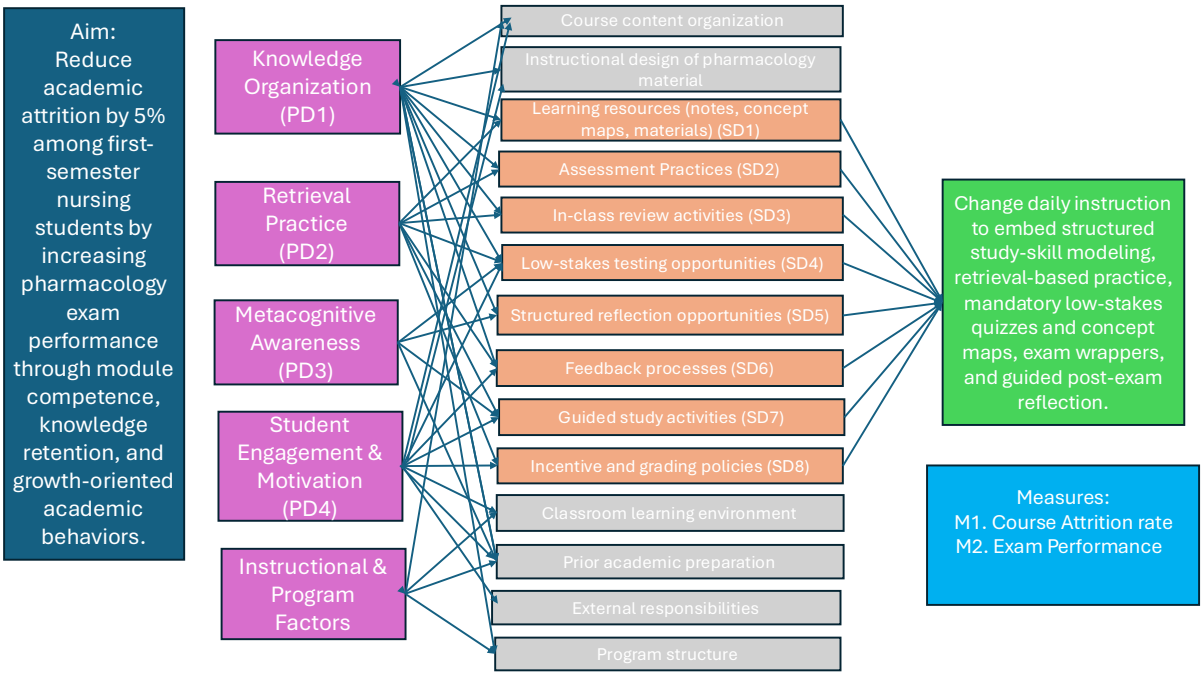
intervention. This process allows improvement efforts to evolve over time while remaining responsive to the needs of the local setting (Langley et al., 2009).

Improvement Science is particularly appropriate for addressing nursing student attrition because attrition is influenced by multiple interacting factors related to learning, instruction, and curriculum design. The literature reviewed in this study suggests that no single intervention is likely to address these challenges independently. Instead, improving student success requires attention to the systems and processes that influence learning. Therefore, Improvement Science provides a practical framework for identifying factors associated with student success, developing evidence-informed interventions, and evaluating their influence on learning outcomes in pharmacology and other high-cognitive-load nursing courses.

Applying these Improvement Science principles, a driver diagram was developed to operationalize the project's theory of change (Figure 1). The diagram synthesizes the evidence presented throughout this literature review by linking the improvement aim to the primary and secondary drivers expected to influence nursing student success in pharmacology. These drivers informed the selection of the intervention components, process measures, and outcome measures evaluated during the PDSA cycles.

Figure 1

Driver Diagram with Measures for Pharmacology Study Skills Intervention



Literature Related to Primary Driver 1: Knowledge Organization

Knowledge organization refers to the processes through which learners structure, connect, and retain information in ways that support future retrieval and application. The literature identifies knowledge organization as an important factor in learning because students must be able to manage large amounts of information while simultaneously developing meaningful connections among concepts. Research related to cognitive load theory and schema development helps explain why knowledge organization is particularly important for novice nursing students learning complex subjects such as pharmacology.

Cognitive Load Theory and the Complexity of Pharmacology Learning

The first set of works examined in this paper centers on what research tells us about people's capacities to learn. Here, the literature on "cognitive load" is instructive (Sweller et al., 2011). "Cognitive load" refers to an individual's cognitive capacity at any particular moment in time. Framed differently, cognitive capacity can be thought of as a particular kind of mental burden that has two primary axes or dimensions. These axes are: intrinsic load and extraneous load. Intrinsic cognitive load refers to the natural and unavoidable complexity of a topic, while extraneous load is the unnecessary mental strain caused by the way a topic is taught or presented to a learner (Sweller, 2010).

Proponents of cognitive load theory posit that an individual's working memory is limited in capacity and duration. When learners encounter new material, their working memory acts as a temporary holding zone for new information until it can be properly stored by the brain for later use. The challenge related to working memory is that information cannot be retained there for very long without rehearsal. Research indicates that working memory reaches capacity quickly. Although Miller (1956) and Peterson & Peterson (1959) originally estimated a capacity of approximately seven items of new information for around 20 seconds, subsequent research suggests that the active focus of working memory is considerably smaller, averaging approximately three to five meaningful items at a time (Cowan, 2001, 2010). More recent investigations continue to support the limited nature of working-memory capacity and its importance for learning and cognitive performance (Morra, 2024). Information that exceeds this capacity is less likely to be effectively processed, organized, and transferred to long-term memory.

These cognitive limitations create learning difficulty when cognitive demands exceed working memory capacity. Working memory can easily become overwhelmed when a task involves multiple interacting elements. Once an individual's cognitive capacity or load is reached, new information cannot be processed. When information is not processed, it cannot be stored in long-term memory.

The strict limit on working memory imposed by cognitive load is especially problematic for students engaged in complex scientific or medical subjects. These fields pose complexity for teaching and learning because the volume of material typically overloads working memory and makes rote memorization exceptionally difficult.

Pharmacology classes offer an important case study for understanding these dynamics and the need for pedagogical alternatives. To learn pharmacological concepts, students must understand and integrate principles and concepts from chemistry, biology, and human physiology. This process is challenging because it threatens to exceed an individual's intrinsic cognitive load (Sweller et al., 2011). As a consequence, unless students have already been exposed to these concepts in prior study, their working memory will be exceeded by the volume and complexity of the course material. When working memory capacity is exceeded, learning becomes substantially more difficult because information cannot be effectively processed and transferred to long-term memory (Chi et al., 1982; Sweller, 2011). Downstream consequences related to course failure and attrition may occur if students' cognitive load is consistently exceeded (Park et al., 2025; Peterson, 2009).

The constraints of working memory tend to be most evident in situations where students are confronted with novel information. For example, a novice student will typically need to dedicate cognitive resources to processing each individual unit of information that he or she is

exposed to; this is because the novice student does not have an existing framework for organizing his/her learning. Conversely, the experienced student will typically require fewer cognitive resources to process large amounts of new information at the same time; this occurs because previous experiences have created a network of relationships (schemas) among what was learned, thereby reducing the amount of demand on working memory. As such, developing these schemas represents a major mechanism by which students can manage their own cognitive loads and ultimately become experts (Benner, 1984; Chi et al., 1982).

Schema Development and Knowledge Organization

Schema development is an essential component of learning because schemas help individuals make sense of, organize, store, and recall information. As schemas become more developed, learners can process increasingly complex information while expending fewer cognitive resources. In this way, schemas help overcome some of the limitations imposed by working memory and support the transfer of information into long-term memory.

Schemas are organized knowledge frameworks that function as dynamic mental structures. Research indicates that schemas facilitate the interpretation, storage, and retrieval of new information by connecting new learning to existing knowledge structures (Neumann & Kopcha, 2018). Developed through prior experiences and knowledge, schemas can be conceptualized as mental representations of concepts and their interconnected relationships (Meylani, 2024). As these mental models become increasingly elaborate through repeated interactions and experiences, they enable individuals to more easily recognize patterns, fill in missing details, and make sense of new and complex information (Meylani, 2024; Milligan, 1979).

Schema theory is particularly important when discussing first-year nursing students, because they are novice learners. The development and use of schemas change dramatically as students progress in their learning journey. First-year nursing students are still developing the foundational knowledge that will become their mental frameworks or schemas, so they tend to memorize individual facts and weigh each piece of new information equally until such times that they develop schemas that enable them to retrieve and draw from their learning with more facility (Benner, 1982). For novice nursing students, the development of schemas is particularly important because it enables them to move beyond memorization and toward the integration and application of knowledge required for clinical decision-making (Benner, 1984; Neumann & Kopcha, 2018).

Taken together, the literature on cognitive load and schema development suggests that knowledge organization is essential for novice nursing students. Students who lack organized mental frameworks may struggle to process, store, and apply complex pharmacology information. Therefore, instructional strategies that help students organize information into meaningful structures are important for supporting learning in high-cognitive-load courses.

While schema development helps explain how learners organize and connect information, it does not fully explain how that information is retained and made accessible over time. Understanding how students strengthen and retrieve newly acquired knowledge requires consideration of retrieval practice theory.

Literature Related to Primary Driver 2: Retrieval-Based Learning

Retrieval-based learning focuses on the active recall of previously learned information. The literature suggests that learning is strengthened when students repeatedly retrieve information from memory rather than relying on passive review strategies. Research related to

retrieval practice, the testing effect, and active recall provides insight into how students retain information and transfer knowledge into long-term memory.

Retrieval Practice and Long-Term Knowledge Retention

While cognitive load theory and schema theory help explain how learners process, organize, and store new information, they do not fully explain how that information is retained and accessed over time. This distinction is particularly important in disciplines such as nursing education, where students must not only learn large amounts of information but also retrieve and apply that knowledge in increasingly complex contexts. Consequently, theories of retrieval practice provide an important framework for understanding how learners strengthen memory, retain knowledge, and access previously learned information when confronted with tasks that require substantial conceptual integration.

Retrieval practice theory suggests that learning is strengthened when students actively retrieve information from memory rather than repeatedly review information that has already been learned (Roediger & Butler, 2011). Retrieval practice is the active, conscious effort to recall or recognize previously learned information (Agarwal et al., 2021). When students recall information, they physically strengthen their memory of it, moving it from short-term to long-term memory (Roediger and Butler, 2011). Retrieval practice requires much more than the passive study methods of reading, re-reading, highlighting, or reviewing materials. It requires an active effort to store information in long-term memory.

The Testing Effect

The testing effect is one of the most extensively researched applications of retrieval practice. While retrieval practice theory explains how active retrieval strengthens learning and retention, the testing effect refers to measurable improvements in learning that occur when

students are required to retrieve information through testing or quizzing activities. Roediger and Butler (2011) define the testing effect as the improvement in future performance resulting from taking tests or quizzes on previously studied material. They argue that testing enhances learning more effectively than passive study techniques such as reading or reviewing slides because it requires active retrieval of information from memory. Through repeated retrieval, memory pathways are strengthened and additional routes for accessing information are created, making future recall more successful (Roediger & Butler, 2011). Similarly, Agarwal et al. (2021) contend that repeated retrieval transforms newly learned concepts into durable memories that are more readily accessible in the future.

The effectiveness of testing depends largely on the type of retrieval that is required. To explain this process, researchers often distinguish between recognition and recall. Recognition involves identifying information as familiar and tends to create a feeling of knowing, whereas recall requires learners to independently retrieve information from memory without external support or cues (Moreira et al., 2019). Although recognition often leaves students feeling more successful in the moment, recall requires active reconstruction of learned material and results in deeper learning and stronger retention (Moreira et al., 2019). Roediger and Butler (2011) similarly argue that the cognitive effort associated with recall strengthens long-term memory and improves the ability to access information when needed in the future.

Passive Review Versus Active Retrieval

When students sit down to study, they tend to draw naturally on the cognitive resources and methods to which they are most accustomed. For many students, default methods are classified as passive study strategies or techniques. They include strategies such as rereading the textbook, reviewing highlighted notes, or reviewing the presentation slides again (Roediger &

Butler, 2011). These habits often feel successful for students. It “looks familiar” and thereby triggers a recognition response (Moreira et al., 2019).

However, to develop the kind of enduring knowledge that facilitates and enables conceptual integration, students need to adopt learning techniques that stimulate retention and recall. These strategies, which are called active learning techniques, include things such as flashcards, practice questions, and low-stakes quizzes (Agarwal et al., 2021; Roediger and Butler, 2011). They are critical because they challenge students to deconstruct and then reconstruct information independently, rather than relying on the textbook or a teacher for an answer. Ultimately, these explicit efforts to improve recall can create new cognitive pathways and schemas, allowing students to more readily access information and build on it for future learning.

The theories discussed thus far help explain how students process, organize, retain, and retrieve information. However, understanding how learning occurs does not fully explain why some students successfully navigate complex academic environments while others struggle. Nursing students must also develop a set of learning competencies that enable them to manage their behavior, regulate their efforts, monitor their understanding, and persist through academic challenges. These competencies are often hidden within the curriculum, yet they play a critical role in helping students learn complex materials and achieve academic success (Sebesta & Bray Speth, 2017; Li et al., 2023).

Literature Related to Primary Driver 3: Metacognitive Awareness

Metacognitive awareness refers to students' ability to monitor, evaluate, and regulate their own learning. The literature suggests that students are more successful when they understand how they learn, accurately evaluate their level of understanding, and adjust their study strategies

in response to feedback. Research related to self-regulation, volitional control, metacognition, and calibration errors helps explain why these competencies are important for academic success.

Self-Regulated Learning

Learning effectively is not achieved by passively absorbing information; effective learners have mastered the management of their behavior, motivation, and learning processes in order to be successful. Learning to adopt new study strategies requires students to develop a range of competencies often hidden within the curriculum. Three concepts are particularly important to understanding this process: self-regulation, volitional control, and metacognition. Together, these concepts help explain how students manage the emotional, behavioral, and cognitive demands associated with learning complex materials and achieving academic goals. While these concepts are closely related, self-regulation addresses how students manage their learning and motivation, volitional control focuses on the implementation of learning behaviors, and metacognition concerns students' awareness and evaluation of their own thinking.

Self-Regulation and Academic Success

In complex academic environments, like high-stress, rigorous nursing programs, self-regulation is important. Critical thinking, clinical judgment, and problem-solving skills are critical for providing safe and effective patient care and are directly linked to a student's ability to manage their own learning (Asadzandi et al., 2022).

Successful, self-regulated learners tend to incorporate several important study strategies. These learners deliberately design their study periods, choosing the most effective methods; they track their understanding as they learn the material; and they tailor their methods based on feedback (Pintrich, 2000; Zimmerman, 1990, as cited in Gibbons et al., 2025). They are not passively receiving information; rather, they actively take charge of their learning and develop a

flexible approach based on self-identified learning gaps and feedback from their assignments and exams.

Volitional Control and Study Strategy Selection

Many students enter higher education, and particularly nursing programs, without these foundational self-regulation skills because they are seldom featured in the American high school curriculum (Sebesta & Bray Speth, 2017). In nursing education, the material goes far beyond the realms of Bloom's lower-order thinking skills 'remembering' and 'understanding' and expects students to use higher-order thinking skills of 'application', 'analysis', and 'evaluation' (University of Florida, 2026). Because so many students enter nursing programs without being explicitly taught how to learn, they tend to rely on outdated, conventional, and highly ineffective study habits from high school (Brown et al., 2014).

Despite the importance of these competencies, nursing education often assumes that students already possess them (Sebesta & Bray Speth, 2017; Sins et al., 2024). As a result, students are expected to navigate complex learning environments without explicit instruction in how to regulate their learning, manage distractions, evaluate their understanding, or modify ineffective study behaviors. This mismatch between instructional expectations and student preparation may contribute to the academic difficulties experienced by many first-semester nursing students (Peterson, 2009; Park et al., 2025).

To attain academic goals, students must do more than understand effective study strategies; they must consistently implement those strategies despite competing demands, distractions, and challenges. This ability reflects volitional control and helps students translate intentions into actions that support learning and academic success (Li et al., 2023).

Metacognition and Self-Monitoring

When a learner is able to think about, plan, monitor, and evaluate their own learning and thinking practices, they are engaging in a higher-order process called ‘metacognition’ (Ebrahimi Ghavam et al., 2024; Dabkowski et al., 2025). Metacognition is an academic term that commonly refers to how individuals ‘think about their thinking’. It is important because it enables learners to evaluate the effectiveness of their study strategies, recognize gaps in their understanding, and make adjustments to improve learning outcomes. Without metacognitive awareness, students may rely on ineffective study habits, overestimate their level of understanding, or fail to recognize when changes in learning strategies are needed. As a result, metacognition is considered a foundational component of self-regulated learning and academic success (Ebrahimi Ghavam et al., 2024).

Calibration Errors in Student Learning

A lack of self-awareness in learning frequently leads to ‘calibration errors’. Calibration in learning is much like determining the accuracy of a machine or device; it refers to how closely a student’s perception of their own performance and effort aligns with their achievement (Achacoso, 2005; Williams, 2021). Beginners and students without metacognitive skills often display a ‘fixed mindset’ that leads to a gross overestimation of their grasp of course materials (Williams, 2021). Calibration errors are common among students who lack metacognitive skills because they do not actively reflect on their thinking. The inability to reflect on their study habits and techniques, and to adapt to the feedback they receive, leads to large gaps in knowledge retention, which eventually results in performance that is sorely mismatched with their perception of understanding.

The lopsided perception versus reality overconfidence is almost always fueled by passive study techniques that create the ‘illusion of knowing’ (Achacoso, 2005; Brown et al., 2014).

Without self-regulated metacognition, students will spend hours passively re-reading their notes or the textbook. They walk into an exam with a sense of familiarity and confidence in their knowledge of the material, but when tested on applying or analyzing the information in a clinical context, the illusion is shattered, revealing knowledge gaps (Achacoso, 2005; Kramer & Mitchell, 2025) and nursing educators' failure to help students increase this capacity. Regardless, by failing to accurately understand what they do not know, students cannot proactively fix their mistakes. When this occurs, poor exam performance and program attrition may result (Peterson, 2009; Park et al., 2025).

Metacognitive Reflection

Metacognition is defined as a person's awareness of their own learning processes and their ability to critically evaluate the study strategies they use (Ebrahimi Ghavam et al., 2024). Metacognitive reflection encourages learners to actively question and heighten their awareness of their study techniques, emotions, and performance to effect change (Merkebu et al., 2024). Metacognitive reflection is an active process of critically examining how a learner thinks, processes, and recalls information, and it involves recognizing incongruities among time, effort, and performance to make better study decisions in the future.

One vital aspect of learning that educators must introduce to students is reflective classroom activities. Because so many students easily fall into the trap of overestimating their abilities, these structured activities encourage students to pause and reflect closely on their study habits. By making self-reflection a deliberate practice, one modeled in class with activities structured to encourage the process, students will gain the necessary insight to objectively evaluate their study techniques and habits while actively identifying knowledge gaps (Dabkowski et al., 2025; Merkebu et al., 2024). Because metacognitive reflection requires

students to evaluate their preparation, performance, and learning processes, instructional strategies that deliberately structure this reflection may help students develop greater metacognitive awareness. One such strategy, guided post-exam reflection through the use of exam wrappers, is discussed later in this review.

Literature Related to Primary Driver 4: Engagement in the Learning Process

Engagement in the learning process reflects students' willingness to persist through challenges, respond constructively to setbacks, and remain actively involved in learning. The literature suggests that mindset, attribution patterns, and resilience influence how students interpret academic difficulty and whether they continue working toward their goals. Together, these concepts help explain why some students persist through challenges while others disengage.

Theories of Intelligence

Mistakes are an integral part of learning, development, and, of course, nursing education. What students take away from those mistakes is crucial. In nursing education, it is imperative that students become resilient in the face of adversity, engage in self-reflection, and actively learn from the mistakes they will inevitably make (Hargreaves, 2025). This is the definition of a growth mindset. A growth mindset is the belief that a student can improve their intelligence, skills, and abilities through effort and effective study (Turaga, 2025). In opposition is a fixed mindset, which is the student's belief that they cannot change their intellectual ability or skill acquisition because these are innate traits; therefore, if they 'fail' an assessment, they are 'failures' (Turaga, 2025). Students with a fixed mindset do not see their failures as learning opportunities; they see them as a judgment on their abilities and do not reflectively recognize that they can change future outcomes by adjusting preparation techniques. Interestingly, current

research has shown that growth and fixed mindsets can coexist, meaning a student can hold a growth mindset in one academic area while simultaneously holding a fixed mindset in another (Ortiz Alvarado et al., 2024). For this reason, cultivating a growth mindset in nursing is imperative, as educators recognize that students will experience failures and setbacks, which are expected. What a student does with those challenges (develop new skills to overcome the hurdle, or give up) makes all the difference.

Fixed Versus Growth Mindset

A student's mindset shapes the characteristics of their educational approach. In a fixed mindset, students see their intelligence as preset and unchangeable. This belief in static intelligence leads students to focus heavily on grades and outcomes while avoiding mistakes to protect their self-image (Turaga, 2025). These students will avoid challenges and give up easily when faced with obstacles (Turaga, 2025). Failure for these students is seen as a direct reflection of their incompetence, and they fail to recognize ways to alter future outcomes (Turaga, 2025). When students stop seeing failure as a personal inadequacy and start to see it as a path to growth, they adopt a growth mindset. These students view challenges as learning opportunities and mistakes as stepping stones to mastery (Turaga, 2025).

Students' academic persistence is at least partially determined by their mindset. Students with a growth mindset are likely to adopt a motivation of "goal mastery", where their primary objective is to genuinely understand the material and improve their own competence (Wichaidit et al., 2025). This goal is more than grade achievement, it is the internal assimilation of and competence in the material. On the other hand, students with a fixed mindset adopt "performance goals." Performance goals are based on proving one's intelligence to others and avoiding negative judgments (Wichaidit et al., 2025). These students are focused solely on the 'passing

grade', not their true understanding of the concepts. Because mastery goals are linked to deeper learning and intrinsic motivation, the students who hold them are more resilient and persistent when faced with hurdles (Wichaidit et al., 2025). It is important to note that the instructor's mindset also plays a role. When students are taught by an instructor with a fixed mindset, they may experience higher levels of stress, increased negative emotions, and be less likely to seek help to overcome challenges (Heyder & Pegels, 2024).

Attribution Theory and Responses to Academic Failure

Attribution theory helps describe, explain, and predict how students rationalize, contextualize, and internalize their own performance (Weiner, 1985). In the research literature, attribution theory is commonly used to explain how learners interpret their success or failure, and later how those attributions influence their future motivations and academic behaviors (Abdulla, 2024). Most students, when failing to attain the grade they aimed for, will blame factors such as internal ability, the effort they put into studying, or the study strategies they used (Weiner, 1985; Abdulla, 2024).

According to attribution theory, students deem these factors as either stable or unstable, controllable or uncontrollable, and internal or external (Weiner, 1985; Abdulla, 2024). For students who hold a fixed mindset, failures are seen as permanent weaknesses and as stable, uncontrollable, internal problems (Dweck, 2006; Abdulla, 2024). By viewing the failure as a permanent internal weakness, these students quickly lose motivation to change their study approaches or techniques as their expectations for improvement have been significantly lowered (Dweck, 2006; Weiner, 1985; Abdulla, 2024). However, when students approach their shortcomings as opportunities to learn, as with a growth mindset, they see their problems as

controllable and temporary, which increases their motivation to improve and encourages them to seek alternative study options (Dweck, 2006; Abdulla, 2024).

Current research on attribution theory offers several recommendations for improving nursing education. First, it highlights the importance of helping students learn to attribute their failures to changeable, controllable, and temporary factors and to see them as growth opportunities. These attributions are important because nurses must be able to adjust their learning and performance quickly, and see medical errors as controllable and changeable factors. They must take every mistake as an opportunity to grow in their patient care and adjust their methods to ensure positive patient outcomes, rather than see them as a permanent lack of ability, which would lead to continued patient harm (Er & Erci, 2021). A "failure positive" mindset, where learners see shortfalls as intelligent steps in creative problem-solving rather than as personal defects, allows students to objectively evaluate their learning and outcomes and to pivot their processes to effect change (Dorland, 2023).

The ways students interpret and respond to academic setbacks have important implications for their motivation, persistence, and ability to recover from challenges. These outcomes are closely related to the concept of academic resilience, which has become an important area of study within nursing education.

Academic Resilience in Rigorous Educational Programs

Research suggests that student burnout is a primary contributor to attrition in nursing and nursing education programs. This burnout stems from heavy academic course loads, difficult clinical rotations, and prolonged exposure to caring for the critically ill and dying (Maslach & Leiter, 2016). In nursing education, the demands of nursing school create a high-pressure environment in which students frequently experience early setbacks and performance anxiety as

they learn unfamiliar clinical diagnoses, identify signs and symptoms of system failure, and understand medications, their effects, and side effects, all while diligently trying to avoid critical mistakes. The results of these demands include emotional exhaustion, cynicism, and a sense of hopelessness that can lead to burnout, and in turn, course failure, program failure, or program withdrawal (Elbarbary et al., 2023).

Research indicates that nursing education programs can help students combat burnout by increasing their academic resiliency. Resiliency, at its core, is a construct that reflects an individual's ability to quickly recover from stress and failure. Academic resiliency reflects a student's ability to bounce back effectively from the stress and failures encountered in academic settings (Elbarbary et al., 2023).

Because nursing school is inherently a high-pressure and high-demand endeavor, the development of academic resiliency is crucial for shaping students' motivation and persistence (Elbarbary et al., 2023). Research suggests that nursing education scholars have developed instructional approaches that may help students develop this important competency.

One such example is the "Grow Your Grit" program, which was studied by Biangone et al. (2025). This instructional intervention was intended to enhance the grit-related academic resiliency of first-semester nursing students. The program was delivered over a six-week period during the first twelve weeks of a Bachelor of Nursing degree at a regional Australian University. The program included four structured modules focusing on key grit-related characteristics: interest, practice, purpose, and hope. Each module included brief, interactive learning experiences combined with guided reflective journaling done each week via the learning management system.

First-year nursing students comprised the sample population (n = 860 eligible; 69 provided qualitative reflection); data collection consisted of themes identified from an analysis of weekly journal entries submitted during the program. Students indicated that they had gained confidence, increased motivation, and enhanced ability to handle both academic and personal challenges as the program progressed. More specifically, participants noted enhancements in time management skills, adaptability, and transition into the nursing role as evidence that structured, reflective interventions could be supportive to early student success and retention (Biangone et al., 2025).

The research on self-regulation, metacognition, mindset, attribution, and resilience provides insight into the competencies students need to succeed in demanding learning environments. The next section examines instructional strategies that educators can use to intentionally develop these competencies and support student success.

Synthesis of the Literature

The literature reviewed in this study suggests that nursing students encounter challenges related to cognitive load, knowledge organization, retrieval, metacognitive awareness, and academic resilience when navigating complex nursing curricula (Sweller et al., 2011; Roediger & Butler, 2011; Ebrahimi Ghavam et al., 2024; Elbarbary et al., 2023). Collectively, these studies indicate that many students enter nursing programs without the learning competencies needed to successfully manage these demands (Li et al., 2023; Sebesta & Bray Speth, 2017). As a result, nursing educators may need to move beyond simply delivering content and instead provide explicit instruction on how to learn within high-cognitive-load environments. The literature identifies several instructional approaches that may support this goal, including study strategy instruction, retrieval-based assessment practices, concept mapping, guided post-exam

reflection, and integrated instructional designs (Sins et al., 2024; Dabkowski et al., 2025; Trumble et al., 2023; Faraji et al., 2025).

Explicit Study Strategy Instruction

Nursing education researchers have identified a need to help nursing students develop both their metacognition and academic resilience. As an alternative to the traditional didactic model of teaching, nursing education scholars have been exploring ways to provide instructional support. One of those methods is explicit instruction in study strategies. Explicit study strategy instruction is where the instructor provides intentional explanations to students about specific learning strategies, when to use each strategy, and why certain strategies will be effective. This method involves the instructor demonstrating evidence-based learning techniques to students (e.g., retrieval practice, visual organization tools) and assisting them in applying these techniques to structured examples until they can do so independently (Rosenshine, 1997). Studies show that explicit instruction on how to learn enhances students' metacognition, self-regulation, and academic achievement, especially in complex learning environment settings (Dunlosky et al., 2013; Li et al., 2023). When the educator teaches students how to study effectively, it helps them develop into self-regulated learners. Self-regulated learners can set goals, use time management techniques, and assess their understanding. These are two of the most important skills required to build confidence and successfully navigate the cognitive demands of nursing education and make decisions regarding patient care (Gibbons et al., 2025).

Retrieval-Based Assessment Practices

Retrieval-based assessment represents a second model for improving students' metacognitive capacities. It refers to a deliberative process of actively pulling information from memory, which is a form of retrieval-based assessment. This is known as active recall, which has

been shown to strengthen memory pathways in the brain more effectively than passive study techniques such as re-reading textbooks, notes, or re-listening to lectures (Roediger & Butler, 2011). Many educators have found that using low-stakes quizzes helps prompt this retrieval process (Agarwal, 2021). However, the timing of these retrieval-based assessments is just as important as the assessments themselves.

Students who space their retrieval practice sessions over days or even weeks disrupt their brain's natural tendency to forget (Khalafi et al., 2024). Frequent but spaced low-stakes testing or quizzing helps maintain students' engagement and minimizes anxiety in advance of major course assessments (Agarwal, 2021). This method of spaced-retrieval-based assessments allows students to accurately gauge their own understanding while reducing test anxiety. However, Agarwal (2021) also reminds teachers that feedback is vital for students to appropriately calibrate their current learning successes and pitfalls.

Overall, research indicates that such feedback is critical to the retrieval cycle because it enables students to correct mistakes and identify their own knowledge gaps simultaneously (Agarwal, 2011). For nursing students, in particular, reviewing the rationales for questions (whether they got the question correct or not) that explain why the correct answer is correct and why the wrong answers are wrong is commonly seen as the most valuable part of using practice questions as a retrieval-based study technique (Sheehy et al., 2024).

Concept Mapping for Knowledge Integration

Another significant strategy in the literature is concept mapping. Concept mapping is a visual strategy that asks students to place key ideas on a page and connect them. The process forces learners to identify relationships, group related concepts, and explain how pieces of

information fit together. Faraji et al. (2025), in a systematic review of more than 20 studies, found that concept-mapping activities supported both critical thinking and clinical reasoning.

Visually representing information is not a new instructional approach; however, concept mapping is not consistently implemented in nursing education despite evidence supporting its effectiveness in promoting critical thinking and knowledge integration (Daley et al., 1999; Novak & Cañas, 2008). Concept mapping can be very beneficial for new nursing students who are struggling to connect several aspects of a disease process or medication. In planning patient care, these maps can help students visually link unfamiliar medical diagnoses to the signs and symptoms their patients present, as well as how those connect with expected lab values and nursing interventions (Dehghanzadeh & Moaddab, 2026).

In pharmacology, concept maps can help students understand the association between a drug's mechanism of action and its expected effects and its potential side effects (Arien-Zakay, 2024). The effectiveness of concept maps has been demonstrated in numerous studies. Doustainouri et al. (2024) conducted a randomized controlled trial examining the effects of concept map instructional training on the clinical decision-making skills of fifth-semester nursing students in a pediatric clinical course. The sample consisted of 50 fifth-semester nursing students. The students were randomly assigned to one of two conditions: an experimental condition consisting of 25 students who received 8 concept-mapping sessions as part of their clinical experience, or a control condition consisting of 25 students who received traditional lectures.

Results showed that the concept-mapping group had a statistically significant increase in clinical decision-making scores post-instruction compared to pre-instruction ($p < .01$). No significant differences were found between the control and experimental groups' clinical

decision-making scores when pretest scores were accounted for. Even though there was no statistical significance between the two groups, the results indicate that concept mapping may help students develop their ability to organize and apply clinical knowledge over time.

Concept mapping requires students to actively create mental connections between their prior knowledge and new concepts. In addition, creating these connections will help students in developing schemas related to their learning, by linking new information to their current understanding (see also Faraji et al., 2025).

Guided Post-Exam Reflection

Guided post-exam reflections are one way the research suggests that students can be moved into active roles in their learning. In general, when students look at their exam grades, they immediately move on without reviewing their mistakes. Research indicates that exam reflections can help students understand exam mistakes, as well as the strengths and limitations of the study techniques that contributed to their final grade (Dabkowski et al., 2025). Researchers claim that these reflections remove the passivity of test-taking and create an environment of evaluation and reflection, allowing students to objectively identify mistakes in their preparation and encourage course correction for future exams.

One of the most effective ways to encourage guided post-exam reflection is the use of exam wrappers. An exam wrapper is a structured reflection tool used shortly after an assessment that allows students to debrief their performance and adjust their habits before the next assessment (Gibbons et al., 2025; Williams, 2019). Although titled “exam wrapper,” this tool can be modified for use after other types of assessments, including clinical skills competencies. Exam wrappers can also be used with or without student access to the exam questions to

maintain test integrity, and either format promotes critical self-reflection on the student's study techniques, time, and effort relative to their results (Chin et al., 2024).

Exam wrappers encourage students to critically assess their own learning in three areas: how they studied, the types of errors they made, and how they plan for future assessments. A typical exam wrapper can be completed before or after reviewing a graded exam and asks students to identify the study strategies they used, how much time they spent preparing, and what they found most challenging about the exam (Achacoso, 2004). Some exam wrappers, such as the one presented in Achacoso's 2004 paper, ask students to predict their exam score before seeing the grade and analyze the types of questions they missed using Bloom's Taxonomy (University of Florida, 2026).

The first section of the reflection examines the student's study techniques for the assessment, as well as the time and effort spent studying. The second part of the wrapper asks students to analyze the types of errors they made on the assessment. These mistakes can range from misreading the question, to second-guessing themselves, to not knowing the answer. Research suggests that by critically reflecting on their errors, students can determine whether they misunderstood the question, changed a correct answer, or simply did not know the information required to answer correctly (Dabkowski et al., 2025). Using Bloom's Taxonomy, students can determine their level of understanding by assessing whether they can adequately synthesize the material and apply it in unfamiliar scenarios.

The last part of the reflection involves students developing a concrete plan of action based on the mistakes they made and the study methods they used, to prepare more intentionally for the next assessment (Chin et al., 2024; Dabkowski et al., 2025; Williams, 2021). Such reflective tools help students take responsibility for their mistakes and tie those mistakes directly

to their preparation and performance with a meaningful strategy for improvement. They also help students differentiate between memorization and comprehension, thereby leading to better learning and academic outcomes (Gibbons et al., 2025). Students who adopt a growth mindset, who believe their intelligence is within their control and changeable, can use this feedback to create a concrete plan to prepare for the next exam (Williams, 2018).

Integrated Instructional Approaches in Nursing Education

Higher education in general, and nursing education in particular, has been slowly transitioning away from the traditional lecture-based teaching format. Diverse student populations require course redesign that includes multi-component instructional methods blended into one cohesive framework (Tomlinson, 2014; Park et al., 2025). To better meet students' learning needs, programs are recognizing that structured, active learning environments lead to better outcomes. Rather than relying on a single content delivery method, research suggests that integrating several teaching strategies, like online learning modules for fundamental knowledge paired with hands-on practice, followed by targeted review or reflection, forces students to not only remain engaged in the content but also learn how to apply it (Arien-Zakay, 2024; Park et al., 2025).

In practice, this course redesign is not necessarily about adding materials, but about changing how it is delivered and reinforced. The goal is for all the aspects of the course to align with what students are expected to learn, from the teaching strategies used to the feedback they receive (Fink, 2003). In many academic environments, this means moving away from traditional lecture- and textbook-centered learning and toward shorter lectures with embedded questions and opportunities to work through real-world clinical scenarios that build on the concepts being

covered (Arien-Zakay, 2024). In this way, learning objectives, instructional activities, and feedback work together to support meaningful learning (Fink, 2003).

Such shifts in instructional modality are important because research indicates that students do not struggle with the same concepts, in the same way, or at the same time, necessitating differentiated instructional approaches that respond to individual learning needs (Tomlinson, 2014; Vygotsky, 1978). Students struggle with different concepts in different ways, and rarely is a single safety net enough. Providing students with multiple learning platforms and supports creates an environment in which students are caught before they fall too far behind (Park et al., 2025). Some of the techniques that have been successfully blended into a single course are: clear grading rubrics, continuous, spaced, and low-stakes quizzing, visual mapping exercises, post-exam reflection exercises, and targeted remediation (Park et al., 2025).

When teaching strategies are combined, they reinforce one another. Active learning, reflection, and feedback are no longer seen as separate steps but rather as an interactive, recursive process. Providing multiple modalities for learning and instruction gives students the chance to master the material through visual representations or spaced-retrieval quizzes if written texts cause them to struggle. Allowing students options to meet their learning objectives improves overall performance, reduces course failure rates, and ultimately better prepares them for the demands of clinical practice (Arien-Zakay, 2024).

Although the literature generally supports these instructional approaches, important questions remain regarding how these strategies function when implemented together as part of a comprehensive course redesign. These unresolved questions highlight several important gaps in the current literature.

Gap in Practice

The majority of existing research has demonstrated positive effects for a variety of instructional strategies, including retrieval-based practice, concept mapping, and guided metacognitive reflection. However, many areas of the literature remain underdeveloped. One of the most significant limitations of prior research is that most studies investigating these approaches have used single- or dual-approach methodologies (i.e., each study typically examines one or two approaches). For example, most studies of retrieval practice and concept mapping have examined these concepts in isolation (e.g., Dunlosky et al. 2013; Roediger & Karpicke, 2006; Novak & Cañas, 2008). Similarly, researchers studying metacognitive strategies, such as the use of "exam wrappers" at the end of an assessment, typically evaluate them independent of other educational methods (e.g., Achacoso, 2005; Lovett, 2013). Because much of the existing research has focused on individual instructional strategies in isolation, the effects of combining these strategies have received comparatively little attention in the literature.

This narrow focus of current research leaves educators with very little knowledge about how these strategies interact when layered together in a comprehensive course redesign. There is a strong need in nursing education to study the effects of adopting a multifaceted approach that combines proven methods into a cohesive framework. Does the combining of these interventions, such as explicit study strategy instruction, with spaced low-stakes retrieval, concept mapping, and post-exam reflections create a compounded synergistic benefit for learners? The research is unclear.

Finally, complex subjects such as pharmacology have received surprisingly little attention in this area of nursing education research, despite being a high attrition course normally taken in the first year of nursing school. Pharmacology is critical for all aspects of nursing care, from medication administration to adverse effects and affected lab values, yet nursing students

frequently struggle with the heavy cognitive load, leading to high failure rates and severe skill decline over time (Arien-Zakay, 2024; Prochnow et al., 2024). While some studies have explored new active learning strategies in pharmacology, they tend to focus on medical and pharmacy students, with very few evaluating outcomes for nursing students (Arien-Zakay, 2024). Despite the importance of pharmacology in nursing education, relatively few studies have examined comprehensive, multi-component instructional interventions within nursing pharmacology courses. This gap between learning science research and nursing pharmacology education provides a strong rationale for developing and evaluating integrated educational interventions in this subject area.

Connection to the Driver Diagram

The literature reviewed in this study consistently demonstrates that nursing students are placed in cognitively demanding learning environments (for example, Pharmacology), but they do not consistently have access to effective learning techniques, metacognitive abilities, or personal resilience to succeed. These findings suggest a need for nursing educators to move beyond identifying barriers to student success and toward implementing targeted, evidence-informed instructional strategies.

Aim Statement

The aim of this work is to improve pharmacology performance and reduce undesirable attrition among first-semester nursing students through the implementation of a structured package of evidence-based learning strategies.

Primary Drivers

Achieving this goal will require establishing the necessary conditions to support each learner. Four conditions identified in the literature as essential to supporting nursing students'

learning are: the development of effective methods for organizing knowledge so that complex pharmacology concepts can be stored, connected, and applied; the students' engagement in retrieval-based learning practices that strengthen memory and improve long-term retention; the development of metacognitive awareness so they can accurately evaluate their understanding, monitor their learning, and adjust their study behaviors; and the development of the resilience, mindset, and persistence necessary to navigate academic challenges.

To establish these conditions, nursing faculty members must intentionally modify aspects of the instructional system and process embedded in course design. Such modifications include changes made to the manner in which content is delivered to students; ways in which students actively engage in their learning (through various forms of active learning such as recall, application, reflection); assessment and feedback mechanisms utilized by instructors; and the explicit teaching of effective study strategies and/or metacognitive skills to students. If faculty do not deliberately address those factors, students will continue to use inefficient study techniques and are likely to fail to meet the cognitive demands inherent in most nursing education curricula.

Secondary Drivers

Many practical, evidence-based ideas for change emerged from the literature review. Nursing faculty can explicitly teach students strategies for studying effectively in complex learning situations. Nursing courses can be redesigned through a series of low-stakes, frequent assessments that focus on the retrieval of previously learned knowledge and experiences. Students can engage in the process of creating conceptual maps to help organize new knowledge within existing cognitive frameworks. Post-assessment reflections, facilitated by instructor-provided guidance (hereafter referred to as exam wrappers), can foster students' metacognitive awareness and enable them to reflect on their preparation strategies leading up to exams.

It is also important to recognize that while each individual strategy has merit, no single strategy should be employed in isolation. As discussed in the literature gaps section, the largest gap appears to be how combinations of these strategies will work together within a comprehensive instructional plan. When educators implement multiple strategies alongside other components of an instructional plan, they may be able to develop a more responsive and supportive learning environment that acknowledges the complexities and diversity of student learning.

Learning Question

To what extent does a structured package of evidence-based learning strategies improve pharmacology performance and reduce undesirable attrition among first-semester nursing students?

Conclusion

The literature reviewed in this article supports the need for an improvement effort focused on early nursing student success in pharmacology. Across the literature, student difficulty appears connected to cognitive load, limited knowledge organization, ineffective study habits, weak retrieval practices, limited metacognitive awareness, and challenges related to persistence and engagement. These findings support the selected drivers and reinforce the need for instructional strategies that teach students how to learn, not simply what to learn. Improvement Science provides a useful framework for testing how these strategies function together in a real educational setting and for refining instructional practices over time.

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