# Learning as an Adult and Cognitive Factors in Learning

CHAPTER

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## INTRODUCTION

If you're reading this page, you probably have completed or will soon complete an occupational therapy curriculum and will soon embark on a rewarding and challenging career as an occupational therapist and healthcare provider. The transition between an academic and professional career is truly an exciting point in one's professional development, and for the typical graduate, emotions may range from exuberance and extreme personal satisfaction to uncertainty and anxiousness over a pending national board examination. It is the intent of this chapter and this book to help the reader hold on to the extreme personal satisfaction that comes with completing a challenging academic program and to help manage any uncertainty and anxiousness that is so often typical for a new graduate who is facing a board examination.

This chapter has two sections. Section 1 introduces principles and concepts of lifelong learning, which includes a discussion of learning as an adult, the key differences between entry-level and adult learners, what we know about successful learners, and key determinants of student success and failure. Section 2 introduces cognitive factors in learning and understanding, which include memory and retention, strengths and limitations of working long-term memory, the importance of monitoring comprehension, and helpful cognitive learning strategies. The information in this chapter is intentionally presented in sufficient detail and with supporting evidence because comprehension and adoption of productive learning behaviors are only fostered by understanding and perceived usefulness.

# SECTION 1: LIFELONG LEARNING

It should be evident for individuals who are leaving the folds of an academic institution and embarking on lifelong careers as healthcare professionals that the transition from an academic to a professional career does not signify an end to formal learning. In contrast, graduation day simply signifies the official shift of ownership and responsibility for lifelong learning to the new graduate, a responsibility that will undoubtedly affect both professional opportunities and define professional reputations. The following paragraphs will discuss lifelong learning as an adult and discuss factors that can help account for student success.

### Key Terms

Active learning	Learners take an active role in their own learning and are in part responsible for learning outcomes.
Attention	"Arousal and intention in the brain that influence an individual's learning processes. Without active, dynamic, and selective attending of environmental stimuli, it follows that meaning generation cannot occur" (Lee, Lim, & Grabowski, 2007, p. 112).
Human cognitive architecture	The manner in which structures and functions required for human cognitive processes are organized (Sweller, 2007, p. 370).
Knowledge generation	"Generation of understanding through developing relationships between and among ideas" (Lee, et al., 2007, p. 112).
Long-term memory	Component of the information-processing model of cognition that stores all knowledge and skills in hierarchical networks.
Meaning making	"The process of connecting new information with prior knowledge, affected by one's intention, motivation, and strategies employed" (Lee, et al., 2007, p. 112).
Memory	The mental faculty of retaining and recalling past experiences (Seel, 2007, p. 40).
Motivation	"The choice people make as to what experiences or goals they will approach or avoid and the degree of effort they will exert in that respect" (Crookes & Schmidt, 1991, p. 481).
Problem solving	"A process of understanding the discrepancy between current and goal states of a problem, generating and testing hypotheses for the causes of the problem, devising solutions to the problem, and executing the solution to satisfy the goal state of the problem" (Hung, Jonassen, & Liu, 2007, p. 486).
Self-concept	An individual's total picture of him- or herself (e.g., self- definition in societal roles, beliefs, feelings and values) that is typically focused on societal and personal norms.
Self-efficacy	An individual's belief that he or she can attain his or her goals or accomplish an identified task or tasks.
Self-regulation	Active participation in one's own learning process in terms of behavior, motivation, and metacognition in one's own learning process.
Sensory memory	A component of the information-processing model of cognition that describes the initial input of information (such as vision or hearing) (Lohr & Gall, 2007, p. 80).
Working memory (i.e., once referred to as short-term memory)	The structure that processes information coming from either the environment or long-term memory and that transfers learned information for storage in long-term memory (Sweller, 2007, p. 370).

# Lifelong Learning as an Adult

Although there are numerous philosophies, theorists, theories, and models supporting adult learning, there is good consensus on the characteristics that make up the deliberative adult learner. Adult learning characteristics also comprise the emotional, psychological, and intellectual aspect of an individual and minimally include the following traits and behaviors (Knowles, Holton, & Swanson, 1998; Merriam & Caffarella, 1999; Snowman & Biehler, 2006):

- Experience: The adult learner utilizes prior knowledge and experience as a vehicle for future learning, readily incorporates new knowledge into similar prior learning, and appreciates the application of knowledge in the context of real-life problems.
- Self-concept: The adult learner moves away from self-concept based on dependency and toward a self-concept based on self-direction and personal independence.
- Communication: Adult learners become increasingly able to effectively express and exchange feelings, thoughts, opinions, and information through verbal and nonverbal modes of communication and varied forms of media.
- Orientation to learning: Adult learners increasingly move away from a subject-centered orientation toward knowledge that will be applied at some future point in time to a problem-specific application of knowledge in the context of real-world problems.
- Motivation to learn: Motivation toward learning shifts away from extrinsic incentives, such as course grades, and becomes increasingly directed toward intrinsic incentives, such as the completion of defined goals and tasks in the fulfillment of social and professional responsibilities.
- Responsibility: Adult learners are capable of reflective reasoning. They analyze knowledge, personal behaviors, and interactions on an ongoing basis; incorporate constructive feedback; and adapt knowledge, behaviors, and interactions to reflect ethical societal standards and values.
- Intrapersonal and interpersonal skills: Adult learners increasingly develop the ability to work independently and cooperatively with others and across varied circumstances and issues that affect the common well-being and one's own well-being in relationship to the world around them.
- Critical inquiry and reasoning: Adult learners increasingly develop the ability to examine and utilize reasoning and decision-making strategies to select, apply, and evaluate evidence in the context of real-world problems.

Although many characteristics of the model adult learner can be identified in adult learning philosophy and theory, we can certainly agree that seeking to achieve the previously described attributes would be a worthwhile endeavor. Now that we know important characteristics of an adult learner, let's make a simple comparison between college-level learning characteristics and adult learning characteristics, as depicted in **Table 2-1** (Knowles, et al., 1998; Merriam & Caffarella, 1999; Snowman & Biehler, 2006).

Now that we've identified key characteristics of the adult learner and compared them to typical college-level learning, it should be apparent that the attributes identified in the right column of Table 2-1 are well-aligned with lifelong professional development and achievement. Relative to the task at hand (i.e., successful completion of the NBCOT), and in terms of common obstacles to learning and achievement, some of the greatest barriers to learning arise from discrepancies between learner behavior and expectations and authentic real-world expectations and anticipated outcomes. In practical terms, holding on to entry-level or college-level behaviors and expectations while preparing for the NBCOT would be expected to hinder preparedness and potentially limit achievement and confidence. The following paragraphs will describe why adult learning behaviors are well aligned with learner achievement, so regardless of where you fall on the spectrum of entry-level to adult learning behaviors, it's officially time to jump aboard the adult learning bandwagon.

# What We Know About Successful Self-Directed Learners

Over the years, much effort has been directed toward understanding the complexity of the learning process and to identify the determinants or attributes that account for student success and failure (Carroll, 1989; Flippo & Caverly, 2008; Morrison, Ross, & Kemp, 2006; Rachal, Daigle, & Rachal, 2007; Spector, Merrill, Merriënboer, & Driscoll, 2007). Although it is obvious that there are many fixed factors that we cannot change in preparation for an examination, such as intelligence quotient (IQ),

	College-Level Learning	Learning as an Adult	
Instructor	The instructor is the source of knowledge, decides what is important and what will be learned	If present, the instructor is a facilitator or resource, and learners evaluate needs based on real-world goals and problems and decide what is important to be learned	
Learning	Passive learners and individual work	Active learners, teamwork, and collaboration	
	Accept learning experience and knowledge at face value	Validate learning experience and knowledge based on experiences and usefulness	
Content	Homogeneous and stable content	Diverse and dynamic content	
	Content learned in the abstract	Content learned in context	
Organization	Learning is organized by subject and content area	Learning is organized around personal experiences, context, and problem solving	
Orientation	Acquiring entry-level competencies	Acquiring real-world problem-solving competencies	
Utility	Developing subject matter attitudes, knowledge, and fundamental skill sets	Developing lifelong learning attitudes, expertise, and advanced skill sets	

Table 2-1 Comparison of College-Level Learning and Learning as an Adult

there are a number of adaptable factors or variables that will, in part, determine your successfulness on the NBCOT, as specifically introduced and discussed as follows (**Table 2-2**):

- Understanding of task requirements: Developing a thorough understanding of NBCOT task requirements should be one of your first objectives. For example, very important task considerations include what is the structure and complexity of the examination, how is the examination administered, when is the examination administered, how do you schedule the examination, what documentation needs to be completed by your university before you can schedule an examination date, when do you report on the day of the examination, can you find a testing center without getting lost, and what do you do if you need to reschedule. Additionally, a thorough understanding of task requirements will set your mind at ease and avoid any unnecessary panic attacks the day before the examination.
- Ability to comprehend and follow instructions: The ability to comprehend and follow instructions begins with the understanding of task requirements and continues throughout the examination preparation process. Because the brunt of the preparation for the NBCOT will be through self-directed learning and preparatory lectures and/or courses, it is important to keep a running list of items that need clarification, principles and concepts you do not fully understand, and even simple task requirements that are not clear. Whether the need for further comprehension is related to the quality of information or gaps in knowledge, you'll need to take deliberate action to seek help from resources such as your textbooks, journals, former professors, peers, clinical mentors, and/or the American Occupational Therapy Association (AOTA).
- Basic aptitudes and general abilities: Regardless of fixed factors, such as intelligence quotient, basic aptitudes and general abilities can have a big affect on student success. These factors can encompass very manageable aptitudes and abilities, such as basic computer skills, library skills, and project management skills, to more challenging factors, such as verbal ability. Chapter 3 will offer much advice in terms of study tips, skills, and strategies, but it will be up to the self-directed learner to identify any weaknesses in general abilities and tackle them early on in the examination preparation process.
- Time saved by prior learning: Time saved by prior learning can be a substantial determinant in terms of student success or failure. Regrettably, courses that foster the use of rote recall strate-

gies and fail to ask the learner to recall or apply knowledge beyond the examination or course conclusion have left many learners at a disadvantage. In simple terms, forgetting and relearning can be cognitively taxing and will place additional constraints on available time and resources. This said, regardless of the degree of prior learning you are able to access when you begin preparing for the NBCOT, you'll need to use productive learning strategies to make sure the information gained on day one is still retained on day 45 (i.e., without forgetting and relearning).

- Time allocated to learning: The learner's decision to allocate suitable time to a given learning task is a very important consideration when preparing for the NBCOT. In very simple terms, the time needed should clearly match the time allowed, and sufficient flexibility should be maintained in project management to address additional and unforeseen demands placed on your available time. In terms of examination preparation, if you find that you are frustrated or anxious because you cannot complete scheduled learning objectives in the time that you allowed for a given task, you are simply telling yourself that you have not allowed adequate time for the task.
- Academically engaged time: All learners probably realize that there can be small-to-colossal gaps between time allocated to a learning task and the amount of time actually devoted to learning with understanding. This said, academically engaged time is the time spent fully attending to a given learning task to meet prespecified learning objectives. For example, if a learner has scheduled a 2-hour block of time to achieve a specific study objective and spends half of the time sorting and organizing materials to be learned, sending and receiving text messages, setting up a study playlist on the iPod, and allowing a friend to interrupt, academic engagement was, at best, 50%. From a more practical perception, remaining academically engaged during scheduled study periods would be expected to reduce undue frustration and anxiety levels, allow achievement of study objectives, and potentially open up free time to do activities that you enjoy.
- Environmental characteristics: Recommendations on how to control study environments will be discussed in Chapter 3; however, factors such as a distraction-free environment, location, time of day, and even temperature and lighting can affect study efficiency and effectiveness.
- Quality and organization of instruction: The clarity and adequacy of the instructional material to be learned can have a significant impact on student success. Because preparation for the NBCOT will be predominantly self-directed learning, it will be important to identify and organize quality instructional materials in the initial stages of preparation and to note any gaps that will need to be filled through supplemental resources. The use of this NBCOT preparation text in combination with your course materials, course texts, acquired literature, and the supplemental resources contained on the companion CD-ROM should be more than sufficient for the task at hand.

Now that we've introduced some very important determinants of student success or failure, let's take a step back and identify the determinants that are fully or predominantly under the direct control of the learner, those that are partially controlled by the learner, and those for which the learner will have no control in preparation for the NBCOT.

In reflection, and in context of NBCOT preparation, it should be apparent that attributes under direct learner control include (1) understanding of task requirements, (2) ability to comprehend and follow instructions, (3) basic aptitudes and general abilities, (4) time saved by prior learning, (5) time allocated to learning, and (6) academically engaged time. In fairness, (7) environmental characteristics and (8) quality and organization of instruction are under partial to full learner control, and none of the attributes are outside of direct or partial learner control. In the grand scheme of things, this is great news because as a self-directed adult learner you will have considerable direct control over some of the most important determinants that will contribute to your success on the NBCOT.

#### **Common Obstacles to Learning**

Now that we've discussed characteristics of the adult learner and determinants of learning that are readily modified to achieve successful outcomes, we can discuss common obstacles that can impede

Determinant of Success or Failure	Learner Control	Partial Learner Control	No Learner Control
1. Understanding of task requirements			
2. Ability to comprehend and follow instructions			
3. Basic aptitudes and general abilities			
4. Time saved by prior learning			
5. Time allocated to learning			
6. Academically engaged time			
7. Environmental characteristics			
8. Quality and organization of instruction			

learning and performance. It is our hope that knowledge of these obstacles in combination with sound reflective reasoning will help the reader to avoid many learning obstacle pitfalls.

- Attitude obstacles: Attitude obstacles include making excuses, procrastination, decision avoidance, avoiding seeking help, task avoidance, approach-avoidance conflict behavior (i.e., the fear of something a person desires), lack of commitment or excessive commitment, requiring unattainable perfection, and lack of positive feedback and reinforcement. Although some learners may overlook or underestimate the impact of attitude obstacles, we should take a momentary pause to acknowledge that attitude obstacles can have a significant impact on both learning and performance under many circumstances (Anderson, 2003; Elliot, 1999; Elliot & Covington, 2001; Ferrari, Johnson, & McCown, 1995; Levinger, 1957; Owens, 2001; Ryan, Pintrich, & Midgley, 2001; Steel, 2007).
- Academic self-handicapping: An excellent example of obstacle of attitude is cleverly coined "academic self-handicapping" and is described as "creating impediments to successful performance on tasks that the individual considers important" (Urdan & Midgley, 2001, p. 116). Academic self-handicapping (1) is a conscious decision to pursue a behavior or establish an excuse before or alongside anticipated achievement activity, not after, (2) occurs prior to important situations where the probability of success is uncertain or in doubt, and (3) occurs as a consequence of both specific actions and lack of action (Thomas & Gadbois, 2007; Urdan, 2004). Academic self-handicapping is noted in higher- and lower-level performing college students. Common examples of academic self-handicapping include procrastination, excuses, overinvolvement in nonacademic activities, and choosing socializing in place of examination preparation (Hall, 2000; Urdan, 2004). The psychology behind academic self-handicapping is complex, but the cognitive affective and motivational factors driving academic self-handicapping are most likely a manifestation of avoidance motives driven by a fear of failure or fear of feeling less capable in the eyes of others (Urdan & Midgley, 2001). Additionally, high-self-esteem learners may use self-handicapping to enhance success, and low-self-esteem learners may use self-handicapping to construct plausible explanations for failure (Tice, 1991). Regardless of your circumstances and motivation, academic self-handicapping and the NBCOT do not make a good combination.

Let's take a ridiculously unscientific quiz to see if you may be an academic self-handicapper (see **Table 2-3**).

Well, seeing as this is a ridiculously unscientific quiz, there are no passing or failing scores. However, if you found yourself answering yes to one or more questions without an authentic explanation, you may, in fact, be an academic self-handicapper. The good news is that because academic self-handicapping frequently occurs before an anticipated important event

#### Table 2-3 Academic Self-Handicapper Quiz

	Yes	No
I typically put off preparing for an examination until the last minute.		
I typically put off completing homework until the last minute.		
I allow my friends to distract me from paying attention in class.		
I allow my friends to distract me from examination preparation.		
When I do poorly on an exam it's typically because I didn't try.		
When I do poorly on an exam it's typically because I'm involved in many activities and have numerous commitments.		
I tend to procrastinate or I have been labeled as a procrastinator by those who know me best.		
I've been known to socialize the night before an examination even though I am not fully prepared.		
I know I could have gotten better grades in certain courses if I just spent the time studying.		
I have difficulty performing well on exams because of lack of sleep.		
I often tell my friends that I don't expect to do well on an examination for reasons such as illness and excessive commitment.		
When I do poorly on an examination or homework assignment, I always have a good excuse for the poor performance.		
I downplay examination and assignment performance because I feel like my friends and classmates will think of me as stupid if I do poorly.		

(e.g., NBCOT), applicable individuals can seek to avoid these impediments to successful performance.

- Lack of professional skills obstacles: Unlike attitude obstacles, lack of professional skills obstacles does not reflect a conscious or counterproductive behavior; rather, it reflects general ability deficits, such as planning, goal setting, project management, technical skills (e.g., using a computer or conducting an online literature search), or writing skills. Lack of professional skills obstacles additionally includes soft skill sets, such as lack of professional networking and peer interactions and lack of professional contacts.
- External obstacles: External obstacles are usually unrelated to either attitudes or professional skill sets and may reflect highly personal, subjective, and multifactorial experiences. Examples of external obstacles can include the death of a loved one, chronic illness within a family, and financial hardships.

# **SECTION 2: COGNITIVE FACTORS IN LEARNING WITH UNDERSTANDING**

Have you ever completed a challenging 2- or 3-hour lecture composed of predominantly new material and felt like all of the important details and concepts quickly blurred into nothing more than the gist or general picture of the lecture? Additionally, have you ever left a learning experience with a solid framework for the lecture material only to find that by the time you go to study you have forgotten most details and are forced to relearn what was forgotten? If you answered yes to either or both questions, the good news is that you're 100% normal, and although there is no bad news, the implications are that we must recognize these limitations of our cognitive architecture and actively seek to overcome them. The following pages will discuss factors that have considerable impact on learning with both understanding and retention.

## **Memory and Retention**

The previously mentioned 3-hour lecture or forgetting-and-relearning scenario should sound familiar to most readers simply because human working memory is not capable of processing and effectively storing a 3-hour lecture in long-term memory, especially if the information is both novel and cognitively demanding (Sweller & Chandler, 1994). Although human working memory is certainly amazing because it is able to temporarily store and manipulate information related to higher-level cognitive behaviors, such as understanding and reasoning, it presents with an unexpected limitation in that it can only process a few elements of information at any given time (Baddeley, 1992a; Becker & Morris, 1999). Miller (1956) established that working memory can only manage about seven elements of information at a time. This notion or acknowledgment of the number of elements a learner's working memory capacity can effectively manage has endearingly developed into the phrase "the magical number seven, plus or minus two" (Miller, 1956). In practical terms, human working memory is surprisingly prone to errors as the learning task becomes more complex, and under typical circumstances it can hold on to information only for a matter of seconds without rehearsal (Anderson, Reder, & Lebiere, 1996; Baddeley, 1992a; Miller, 1956; Shiffrin & Nosofsky, 1994). This is why we tend to appreciate the "gist" or essence of a learning experience, such as the previously described 3-hour lecture, as opposed to remembering everything.

Let's take a little break to demonstrate capacity limitations of working memory. Please solve the following questions solely in your head or working memory and without the use of any external aids, such as pen and paper; the answers are explained later, so please don't read ahead.

- Question one: What is the four-digit number in which the first digit is one-third the second, the third is the sum of the first and second, and the last is three times the second?
- Question two (from Cooper, 1998): Determine if either of the following statements could be true.
  - **1.** My father's brother's grandfather is my grandfather's brother's son.
  - 2. My father's brother's grandfather is my grandfather's brother's father.

For the typical individual, trying to solve either or both questions without the use of external memory aids, such as paper and pen, would have likely exceeded the processing capacity of working memory. To explain, in situations involving serial processing of four or five independent items, little or no overlap exists between information, and the demands placed on working memory are low. Additionally, understanding or recall of one piece of information will have little or no bearing on the understanding or recall of another information element, and the learning task will not typically become difficult unless the number of independent elements is very high. For example, remembering the carpal bones is relatively simple because there are only eight bones, and forgetting the name of one bone will have no impact on the ability to recall the others (i.e., serial processing). Remembering all the bones in the human body is similar in that the items are unrelated; however, the high number of bones will make the task a bit more difficult. In contrast, the preceding questions require that all information be maintained in working memory and manipulated simultaneously to properly solve the problems (i.e., parallel processing). Incidentally, the answer to the first part of question two is false, and the answer to the second part of question two is true.

#### **Understanding Sensory, Working, and Long-Term Memory**

To manage complex cognitive tasks, individuals must be able to access large amounts of information. Long-term memory effectively stores all of our knowledge (content, skills, and strategies) on a permanent basis, with the ability to recall this information being somewhat more variable (Baddeley, 1992b; Ericsson & Kintsch, 1995). Furthermore, information may only be stored in long-term memory after first being processed by working memory; the activation of long-term memory can only occur by bringing the desired elements into working memory. It is additionally noted that knowledge elements that are activated with high regularity are activated automatically with little to no effort (Ericsson & Kintsch, 1995; Sweller & Chandler, 1994). **Figure 2-1**, which describes the relationships between sensory, working, and long-term memory, is depicted on the next page. Learning as an Adult and Cognitive Factors in Learning



Figure 2-1 Memory Diagram.

Within the constraints of the strengths and limitations of human memory, learning requires a change in the schematic structures of long-term memory (Cooper & Sweller, 1987). Schemata are cognitive constructs that allow an individual to treat multiple elements of information as a single element in terms of imposed working memory demands. Schemata are additionally hierarchical in nature and are usually made up of many interrelated elements, which include both the cognitive representation of the problem and the problem solution. Given that a schema can be managed in working memory as a single element, increased working memory can be left open to address the problem state at hand. A second and equally essential aspect of schemata is the principle of automation. Automation allows for the processing of a schema in an automated fashion in further reducing imposed demands on working memory (Cooper & Sweller, 1987; Sweller, 1999).

For example, a skilled driver of an automobile will identify the many elements associated with the task of driving a car as a single schema in working memory, which, in addition to being automated, imposes few to no cognitive demands on working memory. In contrast, a novice medical student examining a patient for the first time may be presented with considerable information. Assuming a lack of an adequate schema, important information will likely be dropped from working memory, and few cognitive resources (if any) will likely be available to diagnose the patient's condition.

#### What Is Learning?

Defining or describing learning may seem straightforward at first glance (e.g., the accumulation of knowledge), but it is somewhat difficult without first coming to agreement on the functions and outcomes of learning. The process of learning is often associated with relatively short-term classroom or university experiences, and the products of learning are often described in terms of credit hours and grades. In contrast to this perception is the idea that learning is fundamental and essential to individual and professional development, which encompasses the need for individuals to actively accept responsibility for their own learning and actively strive to develop themselves through the course of their lifetime. Robert Mayer (1982, p. 1040) offers a definition for learning that is well aligned with an adult learning perspective, which states "Learning is a relatively permanent change in a person's knowledge or behavior due to experience." This definition has three components, which describe that (1) the duration of changes is long-term as opposed to short-term, (2) change entails the restructuring of the learner's cognitive architecture and/or the learner's behaviors, and (3) the catalyst for change is the learner's definition for learning and memory.

## What Is Metacognition?

In addition to being a very cool-sounding word that you can use to impress your friends and family, metacognition is a very important concept for the adult learner and will certainly have great bearing on successful NBCOT preparation. This said, metacognition simply means thinking about thinking and learning, or knowing how to learn (Winn, 2003). Metacognition consists of two separate processes that occur simultaneously: (1) monitoring progress as you learn and (2) making necessary changes and adapting learning strategies when needed to achieve optimal learning outcomes (Winn, W. & Snyder, D., 1996). **Figure 2-2** represents the minimal necessary skills needed to monitor comprehension of learning, which would additionally include factors such as motivation, attention, self-regulation, goal setting, and project management.

The development of metacognitive self-monitoring skills will play a critical role in the development of active and self-regulated learning behaviors, but it is highly unlikely that the skill set will develop if left to chance (Butler & Winne, 1995; Stone, 2000). It has been shown that novice learners do not evaluate content comprehension or work quality, fail to examine problems in depth, and fail to analyze effectiveness and correct errors as they learn (Ertmer & Newby, 1996).

In contrast, high metacognitive self-monitors are aware of when they need to check for errors, understand why they fail to comprehend, know how to redirect their efforts, and are more likely to use feedback from earlier testing experiences to further develop metacognitive skills and alter metacognitive self-judgments, as compared to novice learners (Ertmer & Newby, 1996; Lin-Agler, Moore, & Zabrucky, 2004).

#### What Do We Know in a Nutshell in Case You Forgot?

- **1.** Information about the world enters working memory through sensory information (e.g., vision, hearing, touch).
- **2.** There are monumental information processing and manipulation differences between the information entering working memory via the senses and information entering working memory via long-term memory.
- **3.** Working memory is greatly limited in both capacity and duration, and these limitations can impede learning.



Figure 2-2 Metacognitive Skills.

- **4.** If the capacity of working memory is exceeded while processing information, some or all of the information will be lost.
- **5.** The efficiency of memory is strongly linked to how we direct our attention. Lack of attention devoted to academic tasks will be expected to decrease learning efficiency and effectiveness to some degree.
- **6.** The robust nature of long-term memory is a function of schemata that allow an individual to treat multiple chunks of information as a single element in terms of imposed demands placed on working memory.
- **7.** Continued review and repetition will reinforce neural connections to information stored in long-term memory.
- **8.** Knowledge that is activated with high regularity is activated automatically with little to no effort.
- **9.** Learning will be more efficient and effective if learning tasks are matched to the strengths and limitations of working and long-term memory.

## What Does All of This Mean in Terms of NBCOT Preparation?

*Learning Requires Comprehension.* Recalling information that you do not understand is highly unlikely. Monitor comprehension by building reflection points into your examination preparation. If information is not getting through or not making sense, adjust comprehension or modify applicable conditional factors accordingly. Conditional factors, such as sleep, nutrition, attention, motivation, anxiety, strategy selection, and study environments, can greatly affect learning recall and retention.

*Learning Requires Relationships, Organization, and Structure.* It is very difficult to recall random knowledge as compared to knowledge that is organized with some structure or in some pattern. Avoid line item or bullet point, book page, and flash card learning for complex principles and concepts because they are not efficient or effective means for learning with understanding.

- Generate understanding by developing relationships between and among ideas.
- Actively associate or connect, and then add new information with, related prior knowledge to progressively construct robust schemata.
- Redefine new information in the context of practical real-world problems that can be solved using the knowledge being studied, or ask yourself how you will use the knowledge being studied in the clinic.
- Link new information to relevant personal experiences and/or historic events to enhance long-term memory storage and retention.

*Learning Is Layered.* Broad concepts can be remembered more easily than details, and if the broad concept is learned and anchored in memory first, details tend to readily fall into place. Conversely, it is much more difficult to learn and retain details if you do not understand how they fit into the big picture.

*Learning Requires Review and Repetition.* Avoid learning–forgetting–relearning pitfalls by using multiple learning strategies, such as concept maps and imagery (as covered in Chapter 3), combined with continued review and repetition to reinforce neural connections to information stored in long-term memory.

*Learning Is Closely Linked to Metacognition Self-Monitoring.* Take control over the cognitive processes engaged in learning by actively thinking about thinking and learning. Monitor retention by thinking about how you think and learn: (1) set goals, (2) select learning strategies that best match the content to be learned and learn how to redirect cognitive efforts, (3) correct errors while you learn and understand why you fail to comprehend when it occurs, (4) analyze the effectiveness of your learning strategies after you complete a learning task, and (5) modify your learning strategies and behaviors when needed, and make certain to use feedback from earlier academic experiences.

*Learning Is Problem Solving.* Learning is "a process of understanding the discrepancy between current and goal states of a problem, generating and testing hypotheses for the causes of the problem, devising solutions to the problem, and executing the solution to satisfy the goal state of the problem" (Hung, et al., 2007, p. 486).

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