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Teaching Metacognitive Skills: Helping Your Physician Trainees in the Quest to 'Know What They Don't Know'

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Medical education accreditation agencies have adopted behavioral expectations for physician trainees that focus on self and practice assessment and improvement, including self-monitoring and goal setting. Considered part of the pool of "generic" or transferable skills vital to the development of self-directed, lifelong learners, these skills seem to be valued by the medical education community in many countries.[1-8] One example is the requirement for US residents to identify their own strengths and weaknesses, and then set specific learning goals as part of the practice-based learning and improvement competency[3] (**Table 1**). Yet, metacognitive skills, which enable the performance judgments and cognitive control necessary for meeting competencies such as practice-based learning and improvement, seem to be infrequently taught and assessed in medical education.[9] The purpose of this article is to provide an overview of metacognition and its importance for trainee learning and practice improvement, and to offer teaching strategies to enhance metacognitive skills of trainees.

BACKGROUND

Many medical education accreditation bodies now include language related to self-assessment, self-directed learning, lifelong learning, and practice assessment and improvement as part of their trainee competencies, roles, or standards.[3-8]

Trainee physicians in the United Kingdom are expected to "identify, document and meet their educational needs,"[4] and all physicians are expected to reflect on their own performance.[10] In Canada, residents are expected to "demonstrate insight into their own limitations of expertise via self-assessment,"[6] and US residents, as part of the practice-based learning and improvement competency, are required to continuously self-assess and use self-directed learning skills to improve patient care.[3,11]

At the same time, it has been noted that physicians seem to have limited abilities to critically examine their own performance in aggregate during unguided self-assessments.[12-17] Metacognition, which allows individuals to self-assess and regulate cognitive processes

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related to learning and performance,[18-20] has, until recently, received little attention within the medical education literature.[9]

METACOGNITION AS AN UNDERLYING CONSTRUCT

Metacognitive processes have been described and studied for decades within the fields of psychology, cognitive neuroscience, behavioral neurology, educational psychology, education, and special education. Articles published in the medical education literature have focused primarily on the role of metacognition in clinical reasoning[21-24] and career-long learning.[9]

What Is Metacognition?

In the field of education, metacognition is often referred to as thinking about one's own thinking processes. Yet, metacognition also can be understood as a range of executive system processes[19,25] that are intimately involved in self-assessment, cognitive control, and monitoring,[19,20,26-29] such as controlling the amount of time spent studying and assessing whether we understand a text. Through ongoing monitoring and control of cognition, metacognition enables us to recognize the "absence of knowledge" in a given context.[30] Metacognitive processes depend on a complex interplay of several distinct brain regions known to be responsible for attention to task, self-awareness, memory, and even individual expectations.[31] Historically, metacognition has included the concept of metacognitive knowledge, recognizing that learners must have knowledge or awareness of strategies such as rehearsal, use of mnemonics, and content organization, which can all be mobilized during learning.[25,32,33]

Metacognitive Monitoring

Metacognition as a global set of processes can be parsed into a number of subprocesses, including metacognitive monitoring and control.[26] Metacognitive monitoring refers to those processes we engage in when monitoring our own learning.[19,34] When a reader concludes she has not understood a paragraph just read, metacognitive monitoring processes are at play. The sense that we do not know enough about a particular subject is produced by the cognitive systems involved in monitoring. During metacognitive monitoring, learners judge the difficulty of material to be learned, assess ease in mastering new material, and determine whether something has been learned already.[34] Self-questioning is often used by learners as they monitor their own learning.

PERSPECTIVES VIEWPOINTS

- Residents are expected to identify strengths and weaknesses as part of the practice-based learning and improvement competency.
- Metacognition enables performance judgments and cognitive control necessary for practice-based learning and improvement, yet metacognitive skills are infrequently taught.
- There have been recent calls to highlight metacognitive skills, yet few articles discuss how metacognitive skills can be taught.
- Techniques to enhance trainees' metacognitive skills include reflection, feedback, questioning strategies, and think-aloud techniques.

Metacognitive Control

Metacognitive control, in contrast, refers to the ways in which we control our own cognitive processes during learning,[19] akin to a cognitive manager role. We use judgments of our own knowledge base, previous performance, and expected future performance to regulate our own cognitive processes. Regulating the amount of time spent studying, the pace of studying, and what we study; minimizing off-task behavior; and selecting optimal strategies for studying are examples of metacognitive control over learning.[19,32,34] At times, our trainees may be labeled with medical knowledge deficits, when in reality they may have deficits in metacognitive skills, which can affect their ability to organize and retain new knowledge.[35]

IMPLICATIONS FOR TRAINEE LEARNING

Metacognition helps us plan task completion, monitor progress toward goal attainment, and check for understanding, and is thus considered to be a critical element of the learning process.[18] Metacognitive strategies have been shown to have a direct impact on learning and performance within nonmedical educational contexts (mathematics, reading, writing), especially during problem-solving tasks.[32,36] Within nursing education, researchers noted that metacognitive processes have been linked to the development of clinical reasoning in nurses.[37] In a pharmacy education pilot study, researchers found that learners used metacognitive strategies (visualizing structures or processes) to aid in the retention of newly learned concepts.[35] Burman et al,[9] on the basis of a study of metacognitive skills of pediatric subspecialty fellows, have called for an increased emphasis on the teaching and assessment of metacognitive skills.

IMPLICATIONS FOR PRACTICE

When physician trainees are unaware of their knowledge gaps, they may be unable to critically examine