

Perspective: Viewing “Strugglers” Through a Different Lens: How a Self-Regulated Learning Perspective Can Help Medical Educators With Assessment and Remediation

Steven J. Durning, MD, Timothy J. Cleary, PhD, John Sandars, MBChB, MD, MSc, Paul Hemmer, MD, MPH, Patricia Kokotailo, MD, and Anthony R. Artino, PhD

Abstract

Medical educators are responsible for training current and future generations of physicians; this includes the early and accurate identification of “struggling” medical trainees, which has implications for future training, practice, and success.

The authors propose a theory-based framework, Self-Regulated Learning–Microanalytic Assessment and Training (SRL-MAT), that is specifically designed to foster individual medical trainee self-regulatory beliefs and behaviors, and thus provide a distinct method to assist medical trainees who struggle. The SRL-

MAT is grounded in social–cognitive theory and research and makes a variety of important assumptions about learning and the essential techniques needed to evaluate trainee functioning. Two critical assumptions are that (1) self-efficacy beliefs are a key personal process affecting trainee behavior, and (2) trainee beliefs and behaviors are dynamic and fluid in nature and thus will often vary across educational contexts, as well as for specific tasks within those contexts. To address these assumptions, the SRL-MAT uses an emergent assessment approach called self-

regulated learning microanalysis, a procedure that involves asking a series of temporally sequenced questions about specific regulatory processes as trainees engage in an authentic task or activity. The framework, which is grounded in a foundation of established educational research, is adaptable to practically any task that has a clear beginning and end. The authors believe this framework could make important contributions to traditional medical training assessment frameworks that have been used to identify and remediate strugglers.

Medical educators are responsible for training current and future generations of physicians. Most trainees succeed in

Dr. Durning is professor, Department of Medicine and Pathology, Uniformed Services University of the Health Sciences, Bethesda, Maryland.

Dr. Cleary is associate professor and training director, Department of Educational Psychology, School Psychology Program, University of Wisconsin–Milwaukee, Milwaukee, Wisconsin.

Dr. Sandars is senior lecturer in community-based education and associate director for student support, Medical Education Unit, Leeds Institute of Medical Education, University of Leeds, Leeds, United Kingdom.

Dr. Hemmer is professor and vice chairman for educational programs, Department of Medicine, Uniformed Services University of the Health Sciences, Bethesda, Maryland.

Dr. Kokotailo is professor and associate dean for faculty development and faculty affairs, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin.

Dr. Artino is assistant professor, Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, Bethesda, Maryland.

Correspondence should be addressed to Dr. Durning, Department of Medicine (NEP), Uniformed Services University of the Health Sciences, Bethesda, MD 20814; e-mail: sdurning@usuhs.mil.

Acad Med. 2011;86:488–495.
First published online February 21, 2011
doi: 10.1097/ACM.0b013e31820dc384

completing medical school and residency training and go on to become successful practitioners, at least by our current standards of performance. For this reason, the medical education community should celebrate, as it speaks to the quality of our selection and training rigor, as well as our adaptive curricular innovations.

There are, however, some medical students, residents, and practicing physicians who underperform and, as a result, become major concerns for medical educators, the public, and regulating bodies. These struggling trainees and practicing physicians may exhibit performance difficulties for a wide variety of reasons,^{1–4} such as knowledge deficits,^{5,6} unprofessional attitudes, beliefs, or behaviors,^{6–9} and/or difficulty applying their knowledge and skills to authentic clinical contexts.^{5,10,11} Although we recognize that the types and depths of struggles exhibited by practitioners may differ from those of first-year medical students, we will collectively refer to underachieving or underperforming medical students, residents, and practicing physicians as *strugglers*. Our focus in this article is on struggling trainees (students and

residents), though we believe that the arguments outlined also may apply to struggling practitioners.

Although strugglers represent a minority of those in training and practice, these individuals are at risk for poor performance in the short term (e.g., failure to graduate) and long term (e.g., disciplinary action by a state medical board), which may lead to substantial investments in time and resources by medical educators and professionals. For example, strugglers may need to repeat courses, clerkships, or rotations during residency. Further, faculty and staff often devote considerable amounts of additional time, effort, and resources to strugglers, including serving on student promotion committees, providing additional tutoring, and discussing student or resident performance at departmental meetings. Of even greater societal importance is that medical students, residents, and practitioners who exhibit poor clinical judgment, knowledge, and/or skills may pose a risk of significant harm to the public at large.¹² In addition to suboptimal patient care, strugglers can disrupt the health care system in other ways, including ordering unnecessary tests and obtaining

inappropriate consultations or treatments.

The primary purpose of this article is to introduce an assessment framework, called Self-Regulated Learning–Microanalytic Assessment and Training (SRL-MAT), which we believe could complement traditional medical training assessment frameworks that have been used to identify and remediate strugglers. The SRL-MAT is grounded in self-regulation theory and social–cognitive research and thus assumes that the behaviors and performance of trainees are a function of their motivational beliefs and regulatory processes, as well as the contexts in which they learn and perform their clinical skills.^{13,14} Most researchers conceptualize self-regulation as a dynamic, context-specific process that can be taught and enhanced through direct instruction, guided practice, and tutoring.^{15–17} The primary implication of this concept of self-regulation for assessment practices is that one needs to use assessment methods capable of capturing the dynamic, fluid aspects of self-regulated learning (SRL) by directly examining one’s use of regulation *during* specific activities and in particular domains or contexts. Of greatest practical importance is the volume of research showing that teaching strugglers to set goals, develop strategic plans, self-monitor, and self-evaluate (or reflect on) their performance improves not only their academic success but also their motivation and skills in managing academic behaviors, such as help-seeking and using learning strategies to optimize performance.^{18–20} Positive findings for self-regulation interventions have been found across elementary, secondary, and postsecondary school populations.^{18–20}

The major question that we propose here, however, is whether specific self-regulation assessment and intervention activities (the latter illustrated in Scenario 1 and Scenario 2 in this article) can serve as useful components of the assessment and remediation process used in medical education. Given that self-regulation assessments and interventions have been successfully applied across diverse academic activities (e.g., math, writing, studying) and domains (e.g., athletics, health sciences),^{14,21–24} it is our belief that self-regulation assessment and intervention activities can also be used as an effective supplement to existing

Scenario 1

Assessment and Remediation of Underperformance Due to Inefficient Study Approach*

George is a first-year resident, and his supervisor is concerned that George does not appear to be up-to-date with the latest research when presenting cases on ward rounds. The supervisor probes the possible reasons, and George states that he does not remember what he reads in the journals, despite reading individual articles several times over.

The supervisor uses a structured microanalytic approach to identify key self-regulation processes. George is not that confident that he can remember or understand more than about 50% of what he has read (self-efficacy). His goal is to understand the whole article (goal-setting), and he has no specific technique for reading the article (strategy choice). He does not keep track of what he understands as he reads through the article (self-monitoring), and his mind tends to wander, thinking about the problems on the ward (attention focusing). His overall satisfaction with his understanding of what he has read is low, at about 40% (self-satisfaction). George tries to think of why he does not perform well (self-evaluation) and says that it is all down to his lack of ability (causal attribution), but he keeps using the same approach (adaptive inferences).

The supervisor wants to improve George’s self-efficacy beliefs, and an important first step is to challenge his attribution that his lack of success is due to his innate ability instead of his approach to learning. They discuss how George’s approach to learning can be improved by using short-term goals and strategies that give him the opportunity to check his understanding of what he has read. He can achieve this by summarizing the main points of each section in the article and by clarifying any aspects that appear to be inadequately explained. An important aspect is to maintain attention on what he is doing. George is asked to graph both his self-efficacy score before and after discussing the study at the next ward rounds and also his self-satisfaction score after the discussion.

George is delighted that his self-efficacy score and self-satisfaction have improved. He believed his reason for success was that he was now more actively engaged in reading the article (causal attribution). He also noted that he was more interested in reading last night because he was trying to find an answer to a patient-related question (causal attribution), and he realizes that he could use this to define goals (self-reflection; goal orientation). He now accepts that his performance is under his control and can be improved by using an appropriate strategy (self-efficacy).

* Shown above is an example of an SRL-MAT (Self-Regulated Learning–Microanalytic Assessment and Training) scenario. It illustrates the three-phase self-regulated learning model and the subprocesses of self-regulation that are presented in Figure 1. The authors propose that the SRL-MAT framework could complement traditional medical training assessment frameworks that have been used to identify and remediate underachieving or underperforming students, residents, or practicing physicians.

assessment frameworks in medical schools in helping to identify and remediate strugglers, particularly those with knowledge and skills deficits. We recognize that struggling trainees often have associated psychosocial issues. Although beyond the scope of this article, we believe that such trainees need appropriate support and referral, in conjunction with considering self-regulation assessment and intervention. Further, while in this article we advocate self-regulation assessment and intervention for strugglers, based on literature from fields outside of medicine, we believe this approach could likely benefit all medical trainees, not just strugglers.

Why Focus Our Assessment Framework on Strugglers?

Recent studies have demonstrated that medical school faculty and administrators, as well as regulatory bodies, are becoming increasingly dissatisfied, if not discouraged,

with issues surrounding strugglers.^{1–3,25} For example, concerns about individual medical student confidentiality and the ethical problems associated with the potential bias that may occur if information about poor performance is shared with other (future) course and clerkship directors often present a barrier to developing effective remediation plans, let alone to fulfilling societal obligations. Compounding these issues are pressures to increase medical school class size and the emergence of new medical schools, which could add to the overall number of strugglers.²⁶

Given these problems, an emergent challenge for medical educators involves developing effective ways to not only accurately identify strugglers but also to better understand the primary causal factors underlying their poor performance. Identifying the reasons for one’s poor performance in medical school, residency, or practice is a key first step in developing adequate remediation plans.²⁷

Scenario 2

Comparison of “Traditional” Analytic Approaches to Assessment and Remediation With the SRL-MAT Approach*

A medical student begins his 10-week, third-year internal medicine clerkship rotation with an orientation on Day 1 along with a faculty-developed, 100-item, single-best-answer, multiple-choice examination, which is intended to provide an “early warning” for students who might have an insufficient knowledge base. The examination is scored, and in one week he is notified that he scored two standard deviations below the mean.

Traditional analytic intervention:

The student receives a letter notifying him of the result and the concern that he might need to do some additional preparation for the final examination. He is provided general written guidance about topics to cover and how to make his learning more “active” during the clerkship.

SRL-MAT approach:

The clerkship director (CD) identifies the relevant “teachable” behaviors that could contribute to this poor performance, such as insufficient time spent studying, ineffective study strategies, poor awareness of the effort and time needed to succeed, lack of confidence, and maladaptive reflections following poor performance. The CD then asks the student to meet with her to discuss the results of the examination and to bring his study materials. To examine the student’s beliefs and reactions about this specific test, the CD asks the student a series of self-reflection questions:

What is the primary reason why you think you received this exam grade?

What do you think you need to do to improve?

How confident are you that you can pass the test if you take it again?

What types of things are you feeling right now?

The CD records the student’s responses and uses a scoring rubric to identify how “strategic” the student was in reflecting on his test performance. She then asks the student to demonstrate how he would go about studying a particular topic. That is, the student is asked to think aloud as he “shows” an exemplar of how he studies. Immediately before the think-aloud, the student is asked a series of forethought questions.

Do you have a goal in mind as you begin to study? What is it?

What are you going to do to accomplish that goal?

How confident are you that you can learn all of the information that you need to?

Again, the CD records the student’s responses. She then prompts the student to begin thinking aloud.

They discuss reasons why the student thinks he might not have done well on the examination. He admits he was distracted by a family member’s illness, but he also admits that he has trouble on written examinations. He also knew that the examination did not contribute toward his grade, so he admits he did not try very hard. The CD asks what the student believes he would need to do in order to improve, and he admits that he lacks confidence in his time management, often rereading questions. He really does not think in advance about how to take a test or answer questions. The CD and student go over 10 questions from a standard internal medicine clerkship review book. The student is asked to read the question aloud and then to discuss aloud what he is thinking and the reasons behind choosing or eliminating answers. It is clear that he often rereads the clinical stem portion of the question when he gets to the question that is posed. Test-taking strategies are discussed, such as reading the question before the clinical stem. Practicing this technique, he feels more confident and takes less time with each question.

The CD then asks the student to outline what his plan would be for preparing for the final examination. He discusses that he would plan to practice the technique with five questions each night, and the CD suggests that he choose questions that are related to patients he is caring for and already reading about. He agrees that this would be feasible. They discuss how, before doing the questions, he should think aloud what he is planning to do before answering each question, and practice the technique learned today while timing himself with the examination questions. He agrees to meet with the CD in one week to discuss how things are going and to discuss the learning activities in which he is engaged.

*The authors propose that the SRL-MAT (Self-Regulated Learning–Microanalytic Assessment and Training) framework could complement traditional medical training assessment frameworks that have been used to identify and remediate underachieving or underperforming students, residents, or practicing physicians.

Identification of strugglers: Traditional frameworks of evaluation

Current frameworks in medical education focus on the identification, evaluation, and remediation of struggling trainees and can be broadly grouped into analytic, developmental, synthetic, and competency-based approaches. Within each framework,

the methods or measurements for identification of strugglers include a host of instruments that can be used in a formative and/or summative manner.^{28–30} Some methods involve direct observation of the trainee, whereas others rely on less authentic means, such as the use of multiple-choice examinations.

The analytic framework takes the trainee’s performance “apart”—Greek: *ana* (whole) plus *lytic* (apart)—typically dividing learning outcomes into the domains of knowledge, skills, and attitudes. Developmental frameworks, such as the Dreyfus and Dreyfus²⁸ approach, describe learner performance in progressive steps (e.g., novice and early beginner through expert), typically within a domain of performance. Synthetic models put the learner’s performance together into discrete “steps,” or levels, with each step requiring a synthesis of greater knowledge, skill, and attitude. An example of the synthetic approach is RIME (Reporter, Interpreter, Manager, Educator).³⁰ Finally, competency-based frameworks include the widely adopted competencies of the Accreditation Council on Graduate Medical Education, as well as those of CANMEDS and the Good Doctor.^{31,32} Synthetic and competency-based frameworks are also an example of “role-based” frameworks.³³ Unfortunately, current methods of assessment and remediation in medical education tend to explain little variance (typically, studies explain less than 30% of the variance) in the outcomes of interest, such as professionalism, basic science knowledge, and/or clinical skill.^{1,5–8} If these frameworks were optimal, one would expect to explain more of what contributes to the outcomes of interest. The fact that little variance is explained suggests that other factors are contributing to these outcomes of interest, a notion that is particularly important for those who struggle.

In addition, medical education assessment frameworks, per se, typically do not focus on identifying the causal factors underlying poor performance of strugglers and thus provide minimal guidance to medical educators on how best to remediate these students. For example, if a student fails a written examination, there could be a number of potential causes, such as poor preparation, lack of higher-order thinking skills (e.g., relying on rote recall rather than transformational learning strategies), test anxiety, lack of effort, illness, or a personal crisis. Or, if a resident cannot successfully complete a post-encounter form for an objective structured clinical examination station, the reasons for suboptimal performance could include poor knowledge, poor time

management, communication deficiencies, or poor self-awareness or self-assessment, to name just a few.

Without identifying and understanding the proximal causes of trainee underachievement, it is difficult to pinpoint the most effective ways to assist trainees in improving their performance. In fact, without clearly linking what has been learned in the assessment with subsequent remediation strategies (and the evaluation of “success” during that remediation) or the structured framing of the remediation (e.g., retaking a clinical rotation), we may be unintentionally setting students up to repeatedly fail. Furthermore, because our current assessment frameworks are generally *not* based on well-researched educational models or theories, it is challenging for educators to use and integrate various types of assessment data to generate *practical* recommendations for the assessment of struggling trainees and professionals. Collectively, these shortcomings are important reasons to consider alternative approaches, such as the SRL-MAT, an assessment framework designed to generate information about trainees’ motivation and regulatory skills as they engage in authentic tasks in medical school and residency, such as taking comprehensive exams and performing clinical tasks. In sum, we believe the SRL-MAT can complement current assessment and training frameworks in medical education by delineating an innovative assessment process that identifies deficient self-regulatory processes in trainees and thus provides a direct link between assessment and remediation.

Self-regulation defined (and how it differs from self-assessment)

Social–cognitive researchers have defined SRL as a cyclical process whereby individuals use self-generated feedback about their learning to optimize their strategic pursuit of personal goals.^{34,35} From a social–cognitive perspective, self-regulation is typically conceptualized as a teachable skill that operates as a three-phase cyclical loop (see Figure 1). In short, processes preceding action (forethought) have an impact on learning efforts (performance control), which in turn influence how learners react to and judge their performance successes and failures (self-reflection). Forethought processes, such as goal-setting and strategic planning,

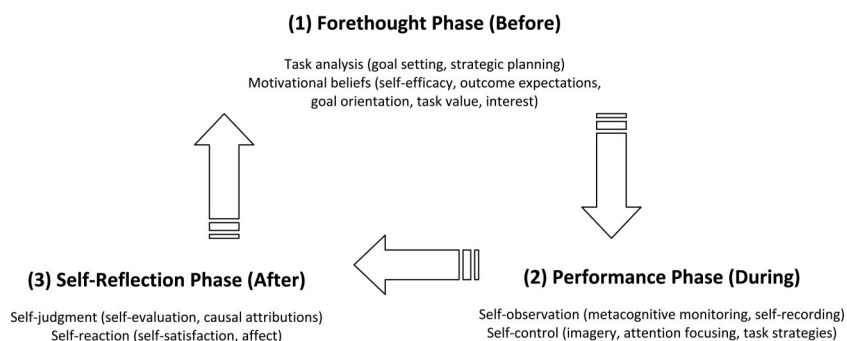


Figure 1 Three-phase, cyclical, self-regulated learning model: phases (before, during, after) and subprocesses of self-regulation. Self-regulation is typically conceptualized as a teachable skill that operates as shown in the figure. (Adapted from Zimmerman BJ, Campillo M. Motivating self-regulated problem solvers. In: Davidson JE, Sternberg RJ, eds. *The Nature of Problem Solving*. New York, NY: Cambridge University Press; 2003:239. Used with permission.)

help to mobilize students’ efforts to learn. Once trainees engage in learning tasks, such as studying for a major exam or drawing blood from a patient, they typically enlist performance-phase processes such as using specific tactics to facilitate task performance (self-control tactics) and tracking the effectiveness of these methods (self-monitoring). The information that trainees gather from task performance is used to judge whether they succeeded or failed (self-evaluation), to judge why this performance occurred (attributions), and to decide what they need to do to optimize future performance (adaptive inferences).

It is important to note that self-regulation and, more specifically, SRL, differs from self-assessment (calibration of one’s perceived performance with actual performance³⁶); self-assessment constitutes just one of the several features of SRL. The medical education literature has found that poor performers are often the most unaware, that is, have the poorest self-assessment skill.^{37,38} This deficit between actual performance and awareness (self-assessment)^{38,39} also suggests that strugglers may possess poor knowledge of task demands or requirements, as well as of their own levels of knowledge or expertise, and may exhibit other problematic self-regulatory skills, such as ineffective use of learning strategies and maladaptive motivational beliefs.

Decades of work by educational psychologists suggest that students can be taught to become more independent and autonomous learners through self-regulation training.^{2,18} Of particular importance is that researchers have begun to show that struggling students can improve the accuracy of their self-

assessments regarding personal capabilities and knowledge *if* they are provided with effective feedback from content experts or teachers and *if* they are taught specific strategies to generate internal feedback, such as error detection and self-monitoring.^{40–42} It is our belief that the SRL-MAT can provide valuable assessment data that can be used by educators to generate and provide task, strategic, and self-regulatory feedback.

The SRL-MAT Framework

Assumptions

The SRL-MAT framework is grounded in social–cognitive theory and research and thus makes a variety of important assumptions about student learning, as well as the essential techniques needed to evaluate student functioning (see Figure 1). According to Bandura’s^{13,14} model of reciprocal determinism, student behaviors or skills, personal processes (beliefs, affect), and environmental factors (teachers, classroom climate) interact and influence each other in reciprocal ways. However, primary emphasis is placed on the role of human cognition and, in particular, self-efficacy perceptions, as a key personal process affecting student behavior. Thus, a medical student who possesses low self-efficacy, or low task-specific confidence, for drawing blood from a patient may exhibit low motivation and/or avoid these types of clinical experiences, which may further elicit negative feedback from his or her professors in medical school. Conversely, if faculty advisors or professionals provide this student with strategic feedback on how to improve his or her clinical skills, the student’s

perceptions of competence may increase while anxiety about this procedure lessens—personal factors that may prompt higher levels of behavioral engagement and motivation.

Another important assumption of the SRL-MAT framework is that behaviors and beliefs are dynamic and fluid in nature and thus will often vary across educational contexts, as well as for specific tasks within those contexts. For example, a medical student may show adequate diagnostic skills when evaluating a patient with new-onset polyuria who has diabetes, but that same student may show poor skill in recognizing a patient with congestive heart failure. From a practical and diagnostic perspective, this context-specific assumption is important because it suggests that effective self-regulation assessment tools should be tailored to specific contexts and tasks or activities within those contexts. The SRL-MAT uses an emergent assessment approach called SRL microanalysis, a procedure that involves asking temporally sequenced questions about specific regulatory processes as trainees engage in an authentic task or activity.^{23,24,43,44}

In contrast to traditional self-report measures that require students to retrospectively provide accounts of their perceptions, beliefs, and behaviors without reference to situational demands or particular contexts, microanalytic measures are customized to particular academic tasks or activities and involve using context-specific questions targeting the various processes of the three-phase cyclical loop (see Figure 1). In this sense, SRL microanalysis seeks to evaluate how students approach, execute, and reflect *during* (as opposed to a long time after) specific tasks or events. The advantage of conceptualizing self-regulation in terms of a cyclical loop relative to specific tasks is that one can evaluate student regulation across virtually any activity or event (e.g., an examination, a history and physical, a written progress note, response to external feedback, or an interaction with a peer) as long as the event has a clear beginning and end (see reference 43 for a more detailed discussion). We have provided simplified example scenarios using the SRL-MAT framework in Scenarios 1 and 2.

Assessment of self-regulation

From our vantage point, trainees who struggle in medical school or residency might lack the regulatory skills to consistently monitor and adapt their learning efforts to maximize their performance. As a result, evaluating these skills and processes during medical training may not only help medical trainers better understand the processes that inhibit growth in their students but also may help them devise remediation or instructional plans to help these students improve. In the self-regulation literature, a variety of assessments are discussed, including paper-and-pencil self-report scales, direct observation, think-aloud protocols, and self-regulation microanalysis.^{16,45–48} Although self-report scales, such as the Motivated Strategies and Learning Questionnaire, are the most frequent type of self-regulation assessment tools and typically have evidence of strong psychometric properties,^{46,47} they are often problematic because of recall and other response biases, as well as the decontextualized nature of the scales. This latter problem is of particular concern because such scales often fail to capture the dynamic, context-specific nature of self-regulation. Furthermore, asking trainees to retrospectively report how they study or learn in medical school or the general strategies that they use (e.g., time management, organization) to succeed will yield minimal information about the thoughts and behaviors that they *actually* display while engaged in authentic clinical tasks, such as interviewing a patient, performing a procedure, or making a specific medical diagnosis. In contrast, assessment tools designed to directly measure self-regulation processes as they unfold in real time during essential clinical tasks and activities have the potential to provide medical educators with more meaningful information that can be used to not only understand potential causes of poor performance in medical school but also to provide insight into the type of feedback and remediation that strugglers may need.

Self-regulation researchers during the last 20 years have developed a variety of alternative assessment tools, such as think-aloud protocols, behavioral traces, and microanalytic assessment approaches, to directly measure self-regulation during specific events.^{16,47,49} The SRL-MAT endorses the use of think-aloud protocols and direct observations,

but it places primary importance on using SRL microanalytic methodology to evaluate the regulatory skills and processes of trainees. In general, this assessment methodology involves comprehensively targeting the cyclical phase processes of self-regulation (e.g., goal-setting, metacognitive monitoring, strategy use, causal attributions) as an individual engages in a well-defined task or activity.²⁴ It is a largely cognitive approach that seeks to identify faulty regulatory processes so that examiners can isolate gaps or deficiencies in how individuals approach (forethought), monitor (performance), and reflect (self-reflection) during their engagement in some specific task.^{43,50} Some of the essential features of SRL microanalysis include the use of (1) individualized assessment protocols, (2) open-ended and closed-ended questions targeting processes within all three phases of the self-regulation cyclical loop (see Table 1), and (3) customized self-regulation questions that are administered at strategic points during learning or performance on a specific task (see reference 43 for a more detailed overview of this procedure).

A variety of research studies have been conducted to illustrate the procedures and utility of SRL microanalysis. Cleary and Zimmerman⁴⁹ conducted one of the first studies to microanalytically examine a comprehensive array of regulatory processes. Using a sample of high school students, the authors elected to use basketball free-throw shooting as the task around which to embed the *forethought* and *self-reflection* phase questions. Immediately preceding a free-throw practice session, the participants were asked specific questions regarding their goals, strategic plans, and self-efficacy in relation to shooting free throws. In that study, for example, the goal question was, “Do you have a goal when practicing your free throws? If so what is it?”; whereas the strategic planning question was, “What do you need to do to accomplish that goal?” The players were also asked a series of questions targeting their self-reflective thoughts following failure. For example, to examine their attributions and adaptive reactions following two missed shots in a row, the participants were asked, “What is the main reason why you missed those last two shots?” and “What do you need to do to improve your performance?”

Table 1

Selected Examples of Self-Regulated Learning Microanalytic Questions Used in the SRL-MAT Framework*

Phases of cyclical feedback loop	Self-regulation processes	Assessment questions
Forethought (before)	Goal-setting	Do you have a goal in mind as you are preparing to draw blood? [†]
	Strategy choice	What do you need to do to successfully draw blood?
	Self-efficacy	How confident are you that you can draw blood on your first attempt?
Performance (during)	Self-monitoring	Do you think that your approach so far is on track to draw blood? Do you feel like you are making any specific errors as you are feeling for the vein now?
	Self-evaluation	What do you use or focus on to determine if you performed well in drawing blood?
Self-reflection (after)	Causal attributions	What is the main reason why you were (were not) able to draw blood from the model (or patient)?
	Adaptive inferences	What do you need to do next time so that you are successful at drawing blood?

* The authors propose that the SRL-MAT (Self-Regulated Learning–Microanalytic Assessment and Training) framework could complement traditional medical training assessment frameworks that have been used to identify and remediate underachieving or underperforming students, residents, or practicing physicians.

† The reference to drawing blood is for illustrative purposes only. The SRL-MAT questions are context-specific and thus can be modified to relevant tasks and content areas.

Examples of specific questions from a medical education context are shown in Table 1, with specific scenarios illustrating the application of these questions in Scenarios 1 and 2.

An important point here is that in Cleary and Zimmerman's basketball study, all questions were targeting specific regulatory processes, were customized to the specific task of interest (basketball free-throw shooting), and were administered as participants practiced their free-throw shooting. Such a procedure allowed the researchers to directly examine student cognition and regulatory processes as they unfolded in real time. Of empirical importance, the authors were able to show that the use of microanalytic questions clearly differentiated expert, nonexpert, and novice free-throw shooters. That is, expert free-throw shooters, who were defined as those shooting over 70% from the free-throw line, displayed higher levels of self-efficacy, set more specific goals, used more effective shooting and technique-related strategies, and were more strategic in their self-reflection following missed free throws than the two other groups.

Several other microanalytic studies have also illustrated the application, psychometric quality, and importance of

SRL microanalysis procedures across diverse fields.²³ In fact, Kitsantas and Zimmerman²² illustrated that SRL microanalytic-based questions not only differentiated among expert, nonexpert, and novice volleyball players but that, when collapsed into a single score, they accounted for 90% of the variance in volleyball serving skill.

Integrating SRL Microanalysis Into Medical Education

SRL microanalytic methodology can be applied to virtually any well-defined task, event, or activity. In medical education, some of the key tasks on which we expect medical students to reach proficiency include history taking, physical examination, and communication. SRL microanalytic questions and methodology can be developed around several of the expected tasks in order to provide educators with real-time, authentic information about the regulatory deficiencies that may underlie poor clinical performance. The basic idea is to identify a task that has both a clear beginning and end, and then wrap the microanalytic assessment approach—involving forethought (before), performance (during), and self-reflection (after)—around such a task. This would allow one to examine how students approach, learn or perform, and reflect on

particular outcomes. In essence, we see the SRL-MAT as an innovative assessment and intervention approach that can be used with current training frameworks for comprehensively identifying, evaluating, and remediating strugglers across the medical education continuum. At this point, however, empirical support for the utility of the SRL-MAT in medical education is needed, and so we hope that investigators will pursue studies to further address such use.⁵⁰

Medical educators' understanding of medical students' or residents' deficiencies in performance (and strugglers' assessment of their performance) is limited. This may be because the component parts of performance in medicine—particularly emphasizing motivation and context—have not been sufficiently defined, assessed, or allowed for real-time feedback to trainees. SRL microanalysis would provide medical educators (and trainees) with information about deficient motivational beliefs, metacognitive skill, and strategy use that adversely affects trainees' performance in medical school and in clinical practice. By generating this real-time feedback, educators would have more pertinent information to guide their remediation attempts with students who are disengaged and at risk for failure or for engaging in poor clinical practice. Some specific examples could include (1) studying strugglers as they take an examination that has given them difficulty, (2) assessing a skill, such as inserting a peripheral venous or central arterial catheter,⁵⁰ (3) breaking down performance while performing a history or physical exam on a patient, or (4) creating an analysis or plan for a patient. Though such techniques require training of investigators (faculty) and fairly intensive use of resources for an individual trainee, we believe such an approach could (and should) be used for "high-risk" individuals, or strugglers. It could be argued that by *not* using a more inclusive, theory-driven approach for the identification and remediation of strugglers, we are, in essence, preparing strugglers to engage in self-defeating cycles of failure and frustration.

Finally, we believe that the rewards from faculty development training in SRL-MAT would go beyond the individual strugglers. Through improved

understanding and enhanced skills for further identifying, evaluating, and remediating strugglers with the SRL-MAT, we believe that dissatisfaction, and even discouragement, with trying to identify and remediate strugglers could dissipate among faculty members.

In conclusion, although strugglers are a minority of medical trainees, effective remediation can often be a challenge, and the outcomes are usually uncertain. Our proposed framework, the SRL-MAT, capitalizes on work being done in other educational settings and is grounded in educational theory. What is more, the SRL-MAT offers the opportunity to identify strugglers, as well as to design and monitor remediation strategies that could potentially help these trainees become not just better learners but, ultimately, better doctors.

Funding/Support: None.

Other disclosures: None.

Ethical approval: Not applicable.

Disclaimer: The views expressed in this article are those of the authors and do not represent the official views of the Department of Defense, the United States Air Force, the United States Navy, the Uniformed Services University, or other federal agencies.

References

- 1 Frelsen SL, Baker EA, Papp KK, Durning SJ. Medical school policies regarding struggling medical students during the internal medicine clerkships: Results of a national survey. *Acad Med.* 2008;83:876–881. http://journals.lww.com/academicmedicine/Fulltext/2008/09000/Medical_School_Policies_Regarding_Struggling.21.aspx. Accessed December 9, 2010.
- 2 Cleary L. “Forward feeding” about students’ progress: The case for longitudinal, progressive, and shared assessment of medical students. *Acad Med.* 2008;83:800. http://journals.lww.com/academicmedicine/Fulltext/2008/09000/_Forward_Feeding__About_Students__Progress__The.2.aspx. Accessed December 9, 2010.
- 3 Cox SM. “Forward feeding” about students’ progress: Information on struggling medical students should not be shared among clerkship directors or with students’ current teachers. *Acad Med.* 2008;83:801. http://journals.lww.com/academicmedicine/Fulltext/2008/09000/_Forward_Feeding__About_Students__Progress__.3.aspx. Accessed December 9, 2010.
- 4 Pangaro L. “Forward feeding” about students’ progress: More information will enable better policy. *Acad Med.* 2008;83:802–803. http://journals.lww.com/academicmedicine/Fulltext/2008/09000/_Forward_Feeding__About_Students__Progress__More.4.aspx. Accessed December 9, 2010.
- 5 Markert RJ. The relationship of academic measures in medical school to performance after graduation. *Acad Med.* 1993;68(2 suppl):S31–S34. http://journals.lww.com/academicmedicine/Abstract/1993/02000/The_relationship_of_academic_measures_in_medical.27.aspx. Accessed December 9, 2010.
- 6 Greenburg DL, Durning SJ, Cohen DL, Cruess D, Jackson JL. Identifying medical students likely to exhibit poor professionalism and knowledge during internship. *J Gen Intern Med.* 2007;22:1711–1717.
- 7 Hodgson CS, Teherani A, Gough HG, Bradley P, Papadakis MA. The relationship between measures of unprofessional behavior during medical school and indices on the California Psychological Inventory. *Acad Med.* 2007;82(10 suppl):S4–S7. http://journals.lww.com/academicmedicine/Fulltext/2007/10001/The_Relationship_between_Measures_of.2.aspx.
- 8 Papadakis MA, Arnold GK, Blank LL, Holmboe ES, Lipner RS. Performance during internal medicine residency training and subsequent disciplinary action by state licensing boards. *Ann Intern Med.* 2008;148:869–876. http://journals.lww.com/academicmedicine/Fulltext/2007/10001/The_Relationship_between_Measures_of.2.aspx. Accessed December 9, 2010.
- 9 Papadakis MA, Hodgson CS, Teherani A, Kohatsu ND. Unprofessional behavior in medical school is associated with subsequent disciplinary action by a state medical board. *Acad Med.* 2004;79:244–249. http://journals.lww.com/academicmedicine/Fulltext/2004/03000/Unprofessional_Behavior_in_Medical_School_Is.11.aspx. Accessed December 23, 2010.
- 10 Fung CC, Relan A, Wilkerson L. Demystifying “learning” in clinical rotations: Do immersive patient encounters predict achievement on the clinical performance examination (CPX)? *Acad Med.* 2007;82(10 suppl):S97–S100. http://journals.lww.com/academicmedicine/Fulltext/2007/10001/Demystifying_Learning_in_Clinical_Rotations__Do.26.aspx. Accessed December 23, 2010.
- 11 Hamdy H, Prasad K, Anderson MB, et al. BEME systematic review: Predictive values of measurements obtained in medical schools and future performance in medical practice. *Med Teach.* 2006;28:103–116.
- 12 Moulton CA, Regehr G, Mylopoulos M, MacRae HM. Slowing down when you should: A new model of expert judgment. *Acad Med.* 2007;82(10 suppl):S109–S116. http://journals.lww.com/academicmedicine/Fulltext/2007/10001/Slowing_Down_When_You_Should__A_New_Model_of.29.aspx. Accessed December 26, 2010.
- 13 Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory.* Englewood Cliffs, NJ: Prentice-Hall; 1986.
- 14 Bandura A. *Self-Efficacy: The Exercise of Control.* New York, NY: W.H. Freeman; 1997.
- 15 Boekaerts M, Pintrich PR, Zeidner M, eds. *Handbook of Self-Regulation.* San Diego, Calif: Academic Press; 2000.
- 16 Zimmerman BJ. Investigating self-regulation and motivation: Historical background, methodological developments and future prospects. *Am Educ Res J.* 2008;45:166–183.
- 17 Puustinen M, Pulkkinen L. Models of self-regulated learning: A review. *Scand J Educ Res.* 2001;45:269–286.
- 18 Butler D. The strategic content learning approach to promoting self-regulated learning: A report of three studies. *J Educ Psychol.* 1998;90:682–697.
- 19 Dignath C, Buttner G. Components of fostering SRL among students. A meta analysis of intervention studies at primary and secondary school level. *Metacognition Learn.* 2008;3:231–264.
- 20 Weinstein CE, Husman J, Dierking DR. Self-regulation interventions with a focus on learning strategies. In: Boekaerts M, Pintrich P, Zeidner M, eds. *Handbook of Self-Regulation.* Orlando, Fla: Academic Press; 2000:727–747.
- 21 Butler DL, Beckingham B, Lauscher HJN. Promoting strategic learning by eighth-grade students struggling in mathematics: A report of three case studies. *Learn Disabil Res Pract.* 2005;20:156–174.
- 22 Kitsantas A, Zimmerman BJ. Comparing self-regulatory processes among novice, non-expert and expert volleyball players: A microanalytic study. *J Appl Sport Psychol.* 2002;14:91–105.
- 23 Cleary T, Zimmerman BJ, Keating T. Training physical education students to self-regulate during basketball free-throw practice. *Res Q Exerc Sport.* 2006;77:251–262.
- 24 Cleary T, Zimmerman BJ. Self-regulation empowerment program: A school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychol Sch.* 2004;41:527–550.
- 25 Hauer KE, Ciccone A, Henzel TR, et al. Remediation of the deficiencies of physicians across the continuum from medical school to practice: A thematic review of the literature. *Acad Med.* 2009;84:1822–1832. http://journals.lww.com/academicmedicine/Fulltext/2009/12000/Remediation_of_the_Deficiencies_of_Physicians.38.aspx. Accessed December 26, 2010.
- 26 Hemmer PA, Ibrahim T, Durning SJ. The impact of increasing medical school class size on clinical clerkships: A national survey of internal medicine clerkship directors. *Acad Med.* 2008;83:432–437. http://journals.lww.com/academicmedicine/Fulltext/2008/05000/The_Impact_of_Increasing_Medical_School_Class_Size.3.aspx. Accessed December 26, 2010.
- 27 Hauer KE, Teherani A, Kerr KM, Irby DM, O’Sullivan PS. Consequences within medical schools for students with poor performance on a medical school standardized patient comprehensive assessment. *Acad Med.* 2009;84:663–668. http://journals.lww.com/academicmedicine/Fulltext/2009/05000/Consequences_Within_Medical_Schools_for_Students.29.aspx. Accessed December 26, 2010.
- 28 Dreyfus SE, Dreyfus HL; California University Berkeley Operations Research Center. A Five-Stage Model of the Mental Activities Involved in Directed Skill Acquisition. <http://www.stormingmedia.us/15/1554/A155480.html>. Accessed December 26, 2010.

- 29 Accreditation Council for Graduate Medical Education. ACGME Toolbox of Assessment Methods. <http://www.acgme.org/outcome/assess/toolbox.asp>. Accessed December 26, 2010.
- 30 Pangaro L. A new vocabulary and other innovations for improving descriptive in-training evaluations. *Acad Med*. 1999;74:1203–1207. http://journals.lww.com/academicmedicine/Abstract/1999/11000/A_new_vocabulary_and_other_innovations_for.12.aspx. Accessed December 26, 2010.
- 31 Royal College of Physicians and Surgeons of Canada. CANMEDS Competency Framework. <http://rcpsc.medical.org/canmeds/index.php>. Accessed April 2010.
- 32 General Medical Council. Good Medical Practice. http://www.gmc-uk.org/guidance/good_medical_practice.asp. Accessed December 26, 2010.
- 33 Van der Vleuten CP, Schuwirth LW. Assessing professional competence: From methods to programmes. *Med Educ*. 2005;39:309–317.
- 34 Zimmerman BJ. A social cognitive view of self-regulated academic learning. *J Educ Psychol*. 1989;81:329–339.
- 35 Zimmerman BJ. Attaining self-regulation: A social–cognitive perspective. In: Boekaerts M, Pintrich P, Zeidner M, eds. *Handbook of Self-Regulation*. Orlando, Fla: Academic Press; 2000:13–39.
- 36 Alicke MD, Klotz ML, Breitenbecher DL, Yurak TJ, Vredenburg DS. Personal contact, individualization, and the better-than-average effect. *J Pers Soc Psychol*. 1995;37:833–846.
- 37 Kruger J, Dunning D. Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-awareness. *J Pers Soc Psychol*. 1999;77:1121–1134.
- 38 Hodges B, Regehr G, Martin D. Difficulties in recognizing one's own incompetence: Novice physicians who are unskilled and unaware of it. *Acad Med*. 2001;76(10 suppl):S87–S89. http://journals.lww.com/academicmedicine/Fulltext/2001/10001/Difficulties_in_Recognizing_One_s_Own.29.aspx. Accessed December 26, 2010.
- 39 Eva KW, Regehr G. Self-assessment in the health professions: A reformulation and research agenda. *Acad Med*. 2005;80(10 suppl):S46–S54. http://journals.lww.com/academicmedicine/Fulltext/2005/10001/Self-Assessment_in_the_Health_Professions__A.15.aspx. Accessed December 26, 2010.
- 40 Butler DL, Winne PH. Feedback and self-regulated learning: A theoretical synthesis. *Rev Educ Res*. 1995;65:245–281.
- 41 Hattie J, Timperley H. The power of feedback. *Rev Educ Res*. 2007;77:81–112.
- 42 Ramdass D, Zimmerman BJ. Effects of self-correction strategy training on middle school students' self-efficacy, self-evaluation, and mathematics division learning. *J Adv Acad*. 2008;20:18–41.
- 43 Cleary T. Emergence of self-regulated learning microanalysis: Historical overview, essential features, and implications for research and practice. In: Zimmerman B, Schunk D, eds. *Handbook of Self-Regulation of Learning and Performance*. New York: Routledge; 2011.
- 44 Schmitz B, Wiese BS. New perspectives for the evaluation of training sessions in self-regulated learning: Time-series analyses of diary data. *Contemp Educ Psychol*. 2006;31:64–96.
- 45 Azevedo R. Understanding the complex nature of self-regulated learning process in learning with computer-based learning environments: An introduction. *Metacognition Learn*. 2007;2:57–65.
- 46 Pintrich PR, Smith DAF, Garcia T, McKeachie WJ. Reliability and predictive validity of the motivated strategies for learning questionnaire (MSLQ). *Educ Psychol Meas*. 1993;53:801–813.
- 47 Winne PH, Perry NE. Measuring self-regulated learning. In: Boekaerts M, Pintrich P, Zeidner M, eds. *Handbook of Self-Regulation*. Orlando, Fla: Academic Press; 2000:532–568.
- 48 Cleary TJ. The development and validation of the self-regulation strategy inventory-self report. *J School Psychol*. 2006;44:307–322.
- 49 Cleary T, Zimmerman BJ. Self-regulation differences during athletic performance by experts, non-experts and novices. *J Appl Sport Psychol*. 2001;13:61–82.
- 50 Cleary TJ, Sandars J. Using microanalysis of self-regulatory processes to understand performance of clinical skills by medical students: A pilot study [unpublished].