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Commentary

COMMENTARY – Professional Development

Using self-assessment to develop metacognition and self-regulated learners

Amy Siegesmund*,†

Department of Biology, Pacific Lutheran University, Rieke Science Center, Tacoma, WA 98447, USA

*Contact: Tel: +253-535-8310; Fax: 253-536-5055; E-mail: siegesam@plu.edu
One sentence summary: Teaching students how to monitor and change their own thinking and learning.
Editor: Marcos Vannier-Santos
†Amy Siegesmund, http://orcid.org/0000-0002-5758-9384

ABSTRACT

Student success is too often challenged by a lack of metacognition and ability to self-regulate learning. This commentary argues that the use of self-assessment to increase student metacognition positively impacts student learning and self-regulation. In addition, several strategies for incorporating self-assessment will be presented.

Keywords: self-assessment; metacognition; self-regulated learning

INTRODUCTION

College presents students with many challenges—both intellectual and personal. For beginning students, one of the biggest challenges academically is realizing that the strategies used in previous learning situations do not guarantee success. As educators, we have had experience with the student that has performed poorly on an exam in spite of his/her hard work. In the past, that hard work resulted in a good grade; it is difficult for the student to reconcile why the same effort does not result in a good grade. As educators, the situation is frustrating because we truly want our students to succeed and because acknowledging and dealing with student unpreparedness takes time away from engaging with the content of our discipline. However, this author argues that by ignoring the former we sacrifice the latter. Furthermore, teaching students to be more effective learners is consistent with national calls in the USA for science students to be taught more than just the content of the discipline. From the American Association for the Advancement of Science (AAAS):

> Therefore, in addition to understanding concepts, undergraduates must have opportunities to develop core competencies to better prepare them to practice biology, as well as to address the complex biology-related issues that our society faces. (AAAS 2011)

Imagine a classroom where students did the following: came to class prepared to engage with the material, took advantage of the learning opportunities during class, created meaningful learning experiences for themselves outside of class and realized that they control their learning and that their actions, not intelligence, determines their success. These self-regulated (or self-directed) learners are able to:

> learn to assess the demands of the task, evaluate their own knowledge and skills, plan their approach, monitor their progress, and adjust their strategies as needed. (Ambrose *et al.* 2010)

Self-regulated learners have agency over their learning before, during and after learning experiences. They are able to effectively evaluate their knowledge and the gaps in their knowledge, determine the effectiveness of their learning strategies and make changes to increase effectiveness in future learning experiences. In the long-term, the self-regulated learner becomes an adaptive expert (Bain 2004)—able to troubleshoot problems, propose creative and innovative solutions, and able to overcome diversity. These skills will lead to success not only in our classrooms, but also in STEM fields that rapidly advance and require professionals to constantly acquire and apply new knowledge.

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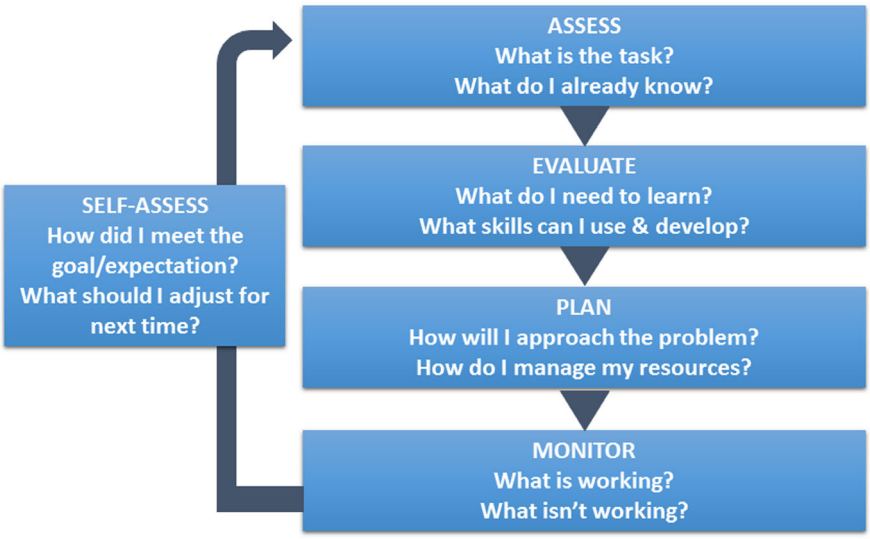

Figure 1. Model of self-regulated learning. Summary of the steps and associated questions in the self-regulated learning cycle. Adapted from Ambrose *et al.* (2010).

The ability of students to effectively self-regulate their learning is dependent on their metacognitive ability (Fig. 1). As defined by Merriam-Webster, metacognition is the 'awareness or analysis of one's own learning or thinking process' (merriam-webster.com). Unfortunately, few students enter college with metacognitive skills. Several studies have demonstrated that students tend to be overconfident in their abilities and overestimate their performance. Worse, this phenomenon, known as the Dunning-Kruger effect, is greater in lower-performing students (Kruger and Dunning 1999). These students will not only perform poorly, but they will fail to recognize their poor performance and as a consequence, do little to positively impact future learning (Dunning *et al.* 2003; Dunning, Heath and Suls 2004). This lack of metacognitive ability prevents students from not only succeeding at an academic level, but also hinders the self-regulated learning that is needed to be a lifelong learner capable of adapting to any learning situation.

SELF-ASSESSMENT AS A TOOL FOR INCREASING METACOGNITION AND SELF-REGULATED LEARNING

Self-assessment is a reflective process where students use criteria to evaluate their performance and determine how to improve. It is important to distinguish self-assessment from self-evaluation (Andrade 2007) where students have input on their grades. Self-assessment is meant to be formative and help students improve subsequent performance. It has been demonstrated that self-assessment is critical for both current and lifelong learning (Black and William 1998, 2009), increases self-motivation (McMillan and Hearn 2008; Bercher 2012), empowers students to take responsibility for their learning (Butler and Winne 1999; Bercher 2012) and leads to increases in student learning (Ibabe and Jauregizar 2010; Siegesmund 2016). Because the process of self-assessment increases metacognition (Siegesmund 2016), students also become more proficient at evaluating their progress toward completing a task, a key facet of self-regulated learning (Ambrose *et al.* 2010).

STRATEGIES TO HELP STUDENTS SELF-ASSESS

There are a wide variety of strategies for using self-assessment to help increase student metacognition and self-regulated learning. The approaches described here (Table 1) were chosen for the relative ease with which they can be implemented. Even so, some instructors may find incorporating such activities intimidating due to lack of experience, negative prior experiences and/or perceptions of student resistance. This author suggests that increasing transparency and student buy-in are essential first steps in overcoming student resistance and providing a positive learning experience for students and instructors. Consider being explicit with students about your pedagogical choices. It is sometimes easy to forget that while the reasons for our instructional choices are clear to us, they may not be clear to students. For example, if you want students to participate in reflective journaling, explain *why*. *How* will performing this task impact their learning? *Why* is it worth their time and effort? A recent study by Brazeal and Couch (2017) suggests that beliefs and perceptions strongly influence student buy-in. Therefore, open conversations with students about how a particular activity is meant to impact learning can increase buy-in and subsequent student engagement. This type of framing (Science Education Initiative 2013) is a small investment of time that can return large dividends in terms of student buy-in and ultimately, student success.

Provide learning objectives that students can use to guide their learning

In 2012, the American Society for Microbiology published a set of learning objectives for microbiology educators (Merkel 2016). Suitable for both majors and non-majors microbiology courses, these objectives align with the Core Concepts outlined in *Vision and Change* (AAAS 2011) and 'enduring understandings' (Wiggins and McTighe 2005). The Society also provides resources for course and lesson plan design using the learning objectives (http://www.asm.org/index.php/in-the-classroom#curriculum).

Table 1. Resources for instructors.

Strategy	Resources
Increasing student buy-in; framing	Brazeal and Couch (2017) Science Education Initiative http://www.colorado.edu/sei/fac-resources/framing.html
Providing learning objectives	Merkel (2016) ASM Curriculum Guidelines and Assessments http://www.asm.org/index.php/in-the-classroom#curriculum Wiggins and McTighe (2005)
Using exam wrappers	Lovett (2013) Sample exam wrappers https://www.cmu.edu/teaching/designteach/teach/examwrappers/
Reflective journaling	Siegesmund (2016) Mynlieff *et al.* (2014) Mair (2012) Ibabe and Jauregizar (2010)
Metacognitively enhancing activities	Tanner (2012)

Providing students a set of learning objectives provides students guidelines that they can use to evaluate their learning (Fig. 1), a critical component of self-assessment.

Incorporate the use of exam wrappers

Following an exam, students too frequently focus on their scores rather than how their approaches impact that score. Exam wrappers (Lovett 2013) are a tool to help students focus on three areas related to exam performance: (1) their preparation prior to the exam; (2) the mistakes they made on the exam; and (3) what changes they should make before the next exam. This process of self-assessment (Fig. 1) allows students to make connections between their behaviors and outcomes and apply that knowledge to influence future learning experiences.

Reflective journaling

These are a writing-to-learn activity where students clarify their thinking about a topic (in this case their own learning) in a low-stakes assignment. Students are provided with prompts (for examples, see Tanner 2012; Siegesmund 2016) that focus on the process of learning and making connections between behaviors and outcome. These reflections allow students the opportunity to practice the cycle of self-regulated learning (see Fig. 1). Further, feedback from the instructor can positively increase students' ability to self-monitor and generate internal feedback (Butler and Winne 1999). Reflective journaling as a mechanism of student self-assessment positively impacts student learning (Ibabe and Jauregizar 2010; Mynlieff *et al.* 2014; Siegesmund 2016), metacognition (Mair 2012; Siegesmund 2016) and self-regulated learning (Ambrose *et al.* 2010; Bercher 2012).

Metacognitively enhancing existing activities

For those initially intimidated by the prospect of incorporating self-assessment, simply adding metacognitive questions to existing coursework is an accessible entry point. These questions can be used with class activities, exams, class periods or the course overall. Questions will help students self-assess in regard to multiple components of the self-regulated learning cycle (see Fig. 1). Tanner (2012) provides a list of questions organized by activity and self-regulated cycle step along with suggestions for classroom implementation.

OUTLOOK

With a focus on training students to 'think like a scientist', we have an obligation to not only teach the content of our discipline, but also to help students become self-regulated learners who can enter the professional world prepared to solve complex problems. This requires us to meet students where they are and provide them opportunities to self-assess and develop their metacognitive skills. Further, we must provide a learning environment where students feel empowered and safe exploring their strengths and weaknesses. A classroom with the type of transparency described earlier is one way to empower students. By helping them understand the choices we make in the classroom, we build rapport and help students feel like partners in the process. Further, classroom learning communities as described by Siegesmund (2016) give students a chance to discover more about themselves as learners. Incorporating self-assessment into the classroom will help students move toward becoming self-regulated, lifelong learners capable of confronting any challenge.

Conflict of interest. None declared.

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