

# Chapter 17

## Metacognitive Strategies and Student Evaluations in a STEM Field

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### ABSTRACT

*This chapter reviews metacognition in relation to college settings while focusing on ways to use this information to help improve student learning outcomes. Metacognition in relation to critical thinking and student evaluations of their own learning is discussed, specifically focusing on the STEM (Science, Technology, Engineering, and Mathematics) area of mathematics. Next, we will elaborate on a pilot study that focuses on asking students metacognitive questions to gain a better understanding of their metacognitive skills in relation to basic statistics courses. This chapter concludes with a discussion of how incorporating metacognitive and critical thinking strategies can impact student learning.*

### INTRODUCTION

*To teach is not to transfer knowledge but to create the possibilities for the production or construction of knowledge. (Freire, 2000)*

This statement by Freire (2000) encompasses good teaching and how we should strive to teach each day. Learning requires more than pouring over textbooks and lecture notes, and for a first-year student,

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“learning” may not come as easily as it used to. Students may be feeling overwhelmed because now their old study habits no longer work. These students are not deeply learning the information. In this chapter, we discuss metacognition in relation to critical thinking and student evaluations of their own learning. Specifically, the STEM (Science, Technology, Engineering and Mathematics) area of mathematics is discussed. By relating critical thinking and metacognition to student evaluations of their own thinking, we hope to shed light on the importance of engaging students in metacognitive activities.

This chapter begins with a discussion on metacognition and its relationship with critical thinking and student self-evaluations. Next we will elaborate on a pilot study that focuses on asking students metacognitive questions to gain a better understanding of their metacognitive skills in relation to basic statistics courses. These courses included students from multiple majors. The relevance of the study is emphasized by the limited research on the relationship between metacognition and student self-evaluations.

It has often been thought that student learning is equal to the grade that a student earns during a course. Frequently this is not the case. The way the material is being studied and the way the material is taught go hand in hand. With that in mind, it becomes clear that new teaching strategies need to be incorporated in classrooms, not only to increase student performance but to ensure that the material is being learned.

Throughout this chapter, it is important to understand that there is no one simple definition of metacognition. The idea of it being *thinking about one's thinking* is not enough. It has complex functions that helps to develop an idea of what cognition is while simultaneously controlling that cognition based on that idea (Efklides, 2006). Metacognition is based in higher order thinking that is involved in “cognitive processes engaged in learning” (Livingston, 2003), so knowing about it and developing metacognitive skills may increase the acquisition of critical thinking skills. In turn, student understanding of their own learning should improve.

This chapter concludes with a discussion of how incorporating metacognitive and critical thinking strategies can impact student learning. By integrating such strategies into classrooms, instructors may not only see an improvement in grades and student learning, but also an increase in knowledge transfer. This information is important to instructors because it can help them in the areas of course design and course development.

This chapter reviews metacognition in relation to college settings while focusing on ways to use this information to help improve student learning outcomes. Learning is more than simply memorizing definitions and formulas. Learning is a part of life. In order to succeed in higher education, it is imperative that metacognitive and critical thinking strategies be utilized courses. This chapter should be of interest to instructors teaching in higher education looking to incorporate metacognitive strategies in their classroom.

## **BACKGROUND**

Metacognition is an important step in the learning process and to the academic success of students in college. It is a deeper level of thinking than cognition by itself. Metacognition is necessary to help create learning goals because you have to think through (plan) each step in order to reach it, and what would be involved in getting to the next step.

Metacognition and critical thinking often go hand in hand when talking about student learning. The concept of metacognition has gained attention in recent years, especially within the fields of developmental and cognitive psychology (Sampaio, 2005). Metacognition can be defined as “thinking about thinking or cognition about cognition” (Ku & Ho, 2010). Similarly, critical thinking encourages stu-

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