Chapter 6
An Integral Approach to Active Learning in Mathematics

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ABSTRACT

In this chapter we examine the notion of "active learning" through Wilber's Integral AQAL Model and through two learning models based on AQAL. Our examination of Edwards' integral learning and Renert and Davis' five stages of mathematics, results in a multi-perspective, multi-level notion of "active learning". We demonstrate, through the development of a rubric to gauge students' "activeness", the complexity of what is involved in the teaching and learning process when one becomes mindful of the perspectives and levels (AQAL) that are present for every student. Several episodes of learning are used to show how each theoretical model applies, and an extended episode, which illustrates a student's repair strategy on a mathematically erroneous concept, is used to illustrate the analysis of the extent of active learning. The chapter concludes with a discussion of how the rubric of active learning, along with the four continua, can help teachers be mindful of the multiple perspectives that influence learning.

INTRODUCTION

In Sir Francis Bacon's (1597) *Meditationes Sacrae*, "*ipsa scientia potestas est*" translates to "knowledge itself is power." Sir Bacon had the insight that the quest for knowledge give learners power throughout the learning process to take control and make use of their ideas. Sadly, such instances of taking control are few and far between for modern day school mathematics learners, who are bogged down by state standards and arguably excessive standardized testing. This book chapter argues and advocates a respectful space in the learning environment so that active pursuit in mathematics learning can indeed empower

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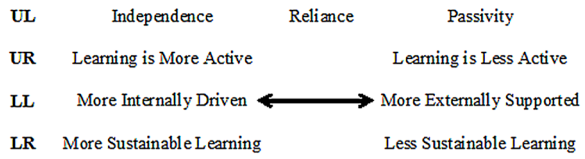
Figure 1. A rubric of four continua in the UL, UR, LL, and LR quadrants describing active learning within the framework of Wilber's Integral Model



the learner to sustain future active learning. Based on the mindful experience of one of the authors, we will examine the meaning of active learning through a fourfold learning dynamic, corresponding to the four quadrants in the Wilber's Integral Model, which will be elaborated on in Figure 1.

To examine these notions we will use three established models: Renert and Davis (2010) five stages of mathematics, Edwards' (2005) integral learning, and Wilber's All Quadrant All Level (AQAL) Integral Model. The three models are used to explain: "What constitutes mathematics?", "How can mathematics be learned?", and "How can learning dynamics be thoroughly and integrally examined?" The examples and illustration of mathematics learning are all drawn from the experience of one college level developmental mathematics and calculus teacher. The students described in this chapter include both the traditional college learners who attended college immediately after high school graduation, as well as the non-traditional college learners who returned to college after a hiatus from formal education since their high school graduation. The results of the examination will have both empirical and theoretical implications. The research account of the author Yuen, a college math instructor, who attempted to engage his students in a genuine learning process, is based on his mindful observations and reflections of what was happening in his classroom. We describe Yuen's observations first in the context of his individual classroom, and subsequently we discuss how to be mindful of a student's learning space as well as the social learning environment, in order to foster active learning in a mathematics classroom.

PROBLEM AND CONTEXT: LEARNING SCHOOL MATHEMATICS

In the context of classroom mathematics instruction, a sociologist might ask why the subject of mathematics seems to have an overall reputation of being stubborn to learn. A psychologist might ask why individual learners suffer from mathematics anxiety. An educator might ask how to best facilitate mathematics instruction. And for individual learners, what should they ask about their mathematics learning? Most ask, "Is that the right answer?" The author Yuen has been teaching mathematics professionally for 15 years, during which time not one single student has ever posed the questions: "What does it mean to do math?" or, "What is math?" Suppose a learner *does* know what it means to do mathematics, then this knowledge could serve as a prerequisite for active learning. In other words, there is a possibility for active learning to take place when the learner knows what he/she is doing. However, it is unclear whether many mathematics learners *do* have a clear idea what mathematics means. Does using a formula mean doing mathematics? Does solving an equation mean doing mathematics? How does an educator constructively instill in learners and empower them with the prerequisite of what mathematics could mean to them and to the academic community as a whole?