

Chapter 29

A Teaching Model for the College Algebra Flipped Classroom

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ABSTRACT

A flipped classroom teaching approach has been used in the teaching of college algebra within a broader initiative for mathematics learning. The flipped classroom approach documented in this chapter utilizes multiple teaching strategies to enhance student learning. From the pilot teaching of two semesters of college algebra, a teaching model was developed using the Joyce, Weil, and Calhoun (2009) framework. The purpose of this study and chapter is to describe the design and development of the flipped classroom teaching model in terms of the design decisions, model implementation, and model evaluation over the two semesters. Student survey responses and interview results suggest that this teaching model improved student perceptions of learning college algebra. Findings reported in this study document the use of the model, while future iterations of the design and development cycle (Richey & Klein, 2007) are necessary to understand the impact of the flipped classroom model on student learning.

INTRODUCTION

According to Haver (2007), the percentage of students withdrawing or earning grades of a “D” or “F” in college algebra courses nationally is more than 45%. One explanation from Harver is

that most college algebra classes focus exclusively on algebraic manipulation skills and spend little time if any on applying these skills outside the classroom. Researchers have identified factors that may contribute to high failure rates in entry-level undergraduate mathematics courses, including a

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student's background knowledge, self-efficacy, perception of the usefulness of mathematics, and motivation (Cardetti & McKenna, 2011; Hall & Ponton, 2005; Thomas & Higbee, 1999). College algebra is often referred to as a "gateway course," one that students must pass before they are allowed to enroll in other courses. Undoubtedly, passing or failing college algebra influences a student's career choices and a student's career trajectory. Changes must be made in the delivery of college algebra in an effort to enhance a student's self-efficacy, motivation, and perception of mathematics, ultimately leading to a rise in student performance.

Bandura (1997) defined self-efficacy as the personal belief in one's ability to be successful at specific tasks or to achieve a specific goal and that an individual relates their self-efficacy to past experiences. For example, in an academic context the nature of a student's experience in a high school mathematics class, positive or negative, might impact how that student feels about his ability to succeed in a mathematics course in college. Hall and Ponton (2005) found that when a student related academic achievement to their personal capability and exerted effort, their mathematics self-efficacy increased.

The National Council of Teachers of Mathematics (NCTM, 2000) associated effective teachers of mathematics with a strong commitment to their students as learners of mathematics and their capability of using a variety of pedagogical and assessment strategies. NCTM (2000) further acknowledged that "students will be served well by school mathematics programs that enhance their natural desire to understand" (p. 21). Ideally, students enter school with knowledge from their cumulative past experiences, both personally and academically, so teachers must design instruction that elicits a student's need to further his understanding and deepen his existing knowledge (Garrison, 2010). Since students' self-efficacy, past experiences, and needs and desires are different from those of their peers, mathematics educators must use a variety of instructional

strategies to engage students, elicit their natural desire to learn, and to reinforce the notion that their learning is possible. Walter and Hart (2009) conducted a teaching experiment where students were invited to work together on tasks that were carefully designed to elicit a mathematical need and found that a conceptually-driven classroom elicits a student's intellectual passion and motivates the student to learn, again reinforcing the idea that teaching strategies can impact students' perceptions of learning.

A pedagogical approach called flipping the classroom could provide instructors of college algebra an opportunity to address the factors that may contribute to high failure rates in entry level undergraduate mathematics courses; specifically, self-efficacy, perception of the usefulness of mathematics, and motivation. The subsequent sections of this chapter will describe the design, implementation, and evaluation of a flipped classroom teaching model used to teach undergraduate students college algebra at a land-grant university in the eastern United States.

BACKGROUND

Teaching Context

Innovative teaching in college algebra has been an ongoing aim at a land-grant university in the eastern United States, and the flipped classroom framework is one step in the continuum of ongoing improvement. One of the goals of the department of mathematics is to incorporate online learning components into entry-level mathematics courses. The department now has an 80-seat and a 120-seat instructional computer laboratory, which enables targeted courses such as college algebra to have dedicated weekly seat-time for all enrolled students. In a given fall semester, there are approximately 1500 on-campus students enrolled in college algebra. The undergraduate mathematics courses share an overarching goal of improving student

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