

Chapter 3

The Continuous and Systematic Study of the College Algebra Flipped Classroom

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ABSTRACT

A flipped classroom teaching approach was used in the teaching of college algebra within a broader initiative for mathematics learning. The flipped classroom approach was documented as an integrated teaching model acknowledging multiple teaching approaches, including in-class cooperative learning, mentored laboratory activities, and online teaching videos. A design and development framework was used to describe the design decisions, model implementation, and model evaluation across three deliveries (cases 1, 2, and 3a/3b) of a college algebra course from fall of 2012 through fall of 2013. Key findings included students perceiving video outside of class as resources and not instruction. What replaced the lecture during face-to-face class time was integral to the success of the flipped classroom teaching approach. The use of videos does not constitute a flipped classroom, but requires an overall teaching strategy with an involved teacher who pays attention to individual student needs.

COLLEGE ALGEBRA: AN EDUCATIONAL MATH PROBLEM

High failure rates in entry-level mathematics courses continue to be problematic across college campuses in the United States. According to Harver (2007), 650,000 to 750,000 students enroll in college algebra nationally each year; however, fewer than 10% of these students intend

to pursue careers in STEM (Science, Technology, Engineering, and Mathematics) fields. Dunbar (2006) stated that fewer than nine percent of students will enroll in first semester calculus after completing college algebra. Many majors require students to pass college algebra and others require trigonometry and/or calculus in addition to college algebra. Most students have to take college algebra and may require additional mathematics

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courses such as trigonometry and calculus. Thus, as a “gateway course” students must pass college algebra before they are allowed to enroll in other courses and failure often deters students from STEM-related majors.

Researchers have identified factors that contribute to these failure rates, including student background knowledge, self-efficacy, and motivation (Cardetti & McKenna, 2011; Hall & Ponton, 2005; Thomas & Higbee, 1999; Walter & Hart, 2009). Expectancy-value theory sheds light on why students choose, persist, and perform specific achievement tasks and should be considered when designing instruction. Students either choose to perform or choose to avoid a specific task based on the value or cost they have associated with it (Eccles et al., 1983). Students avoid tasks that they feel incapable of completing and seek tasks they can successfully complete (Bandura, 1997; Eccles et al., 1983, Stipek, 1998). Bandura (1997) defined self-efficacy as the personal belief in one’s ability to succeed at tasks or achieve particular goals, and that individuals relate their self-efficacy to past experiences. Supporting this idea, Hall and Ponton (2005) reported findings that when students related positive outcomes in their mathematics courses to their personal capability and exerted effort, their mathematics self-efficacy increased. In an effort to accommodate the variety of influences on student motivation and self-efficacy, researchers have stressed the importance of pedagogical decisions, such as the selection of problems that are challenging yet workable (Bandura, 1997; Hall & Ponton, 2005), avoidance of routine skill and drill exercises (Ames & Archer, 1988; Wigfield & Eccles, 1992) and the encouragement of cooperative learning (NCTM, 2000; Thomas & Higbee, 1999; Walter & Hart, 2009).

The flipped classroom teaching model has provided instructors of college algebra with an opportunity to address factors that may contribute to high failure rates in entry level undergraduate mathematics courses, including self-efficacy, perception of the usefulness of mathematics, and

motivation. Case analysis from our preliminary study indicated that the flipped classroom enabled students to take control of the learning process (Ogden, Pyzdrowski, & Shambaugh, 2014). Students felt that having the freedom to ask questions helped them learn, because face-to-face class time was devoted to satisfying their needs. One student said that “[Face-to-face time] was dedicated to what you didn’t know, so you learned. It wasn’t a teacher just teaching everything and saying they think you know something you don’t, you have time to ask about what you don’t know.”

THE FLIPPED COLLEGE CLASSROOM AS A PEDAGOGICAL PRACTICE

Describing a Flipped Classroom

Confusion exists as to what a flipped classroom approach is. Lage, Platt, and Treglia (2000) implemented what they called an inverted classroom approach in an undergraduate economics course. Students were asked to read an assigned topic before class. They viewed videos outside of class, while face-to-face class time was used for “hands on” experiments. Students generally preferred the inverted classroom to a traditional lecture. One student said “I learned more than I ever thought I would in a new, creative, and inspiring way” (Lage et al., 2000, p. 35). Videos were not mandatory, although reading the textbook was. A flipped classroom approach to teaching is not just the use of instructional videos, but rather a pedagogical design that replaces what typically takes place during a face-to-face lecture (passive transfer of knowledge) with engaging activities and assigns the lecture as homework for students to complete autonomously outside of class. The implementation of instructional videos does not imply a classroom flip. Videos, however, can be produced to provide remediation, review, homework solutions, or supplemental lectures (Azedevo, 2012;

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