Chapter 9
Professional Development for Teaching College Mathematics Using an Integrated Flipped Classroom

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ABSTRACT
Any innovative approach to teaching benefits from systematic study on its use augmented by professional development, which serves to sustain the innovation over time for individual use and across an academic program. Ongoing study of using a flipped classroom for mathematics teaching used design and development research (Richey & Klein, 2005) across multiple cases of teaching college algebra (Ogden & Shambaugh, 2016) and subsequent application in other mathematics courses. The chapter summarizes the development of an integrated teaching model for the flipped classroom, a model situated within the strategic plan of an undergraduate mathematics program. The chapter then outlines professional development on using the flipped college classroom for mathematics courses with a face-to-face event and online supporting activities, which serve to sustain and build on learning outcomes for implementation of this teaching innovation.

EXTENDING AN INNOVATION TO PROFESSIONAL DEVELOPMENT
Viewing pedagogical innovations as developmental, we suggest that teaching be systematically studied and accompanied by a professional development plan to ensure responsiveness to student and faculty needs, and appropriate use of resources. This chapter extends our work on the systematic study of a flipped classroom approach for the teaching of college algebra (Ogden, Pyzdrowski, & Shambaugh, 2014; Ogden & Shambaugh, 2016, 2017) and how features of the flipped approach have been used in

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other college mathematics courses. We have field-tested a teaching model for the implementation of the flipped classroom and documented its features using Joyce and Weil’s conceptual approach for Models of Teaching (Joyce, Weil, & Calhoun, 2014).

Section one summarizes the development of an integrated teaching model situated within the context of an undergraduate mathematics program. The idea of an “integrated flipped classroom” extends the scope of teaching decisions based on the goals of a mathematics program. Section two provides professional development (PD) guidelines for implementing the model taking into account the different needs of tenure-track, tenured faculty, teaching faculty and adjuncts. PD activities are organized by a F2F event and follow-up online activities that serve to sustain the implementation of the flipped approach. Both activities keep program outcomes a priority as faculty explore student differences, mathematical content, and the pragmatic challenges of implementing a flipped classroom with video and classroom activities.

**TEACHING MODEL DEVELOPMENT FOR THE FLIPPED COLLEGE MATHEMATICS CLASSROOM**

**Connecting Next Generation Mathematics Content to Next Generation Students**

Educators are challenged with preparing students for success in the 21st century. It is not enough for twenty-first century learners to memorize facts and recall information. As Wagner (2013) so poignantly points out, “The world doesn’t care what you know, but what you can do with what you know.” Brookhart (2010) defines this higher-order thinking by establishing three categories of learning: application, critical thinking, and problem solving. Instructors in the 21st century must teach students how to think, how to solve problems, and how to work cooperatively with others.

A changing student population is entering the traditional classroom with different priorities and different expectations of instructors and the college experience (Strayhorn, 2012). The classroom remains the students’ primary educational experience and unit of success for completing these programs (Tinto, 2012). However, the natural curiosity and motivation of students remains intact, but not well activated in traditional classrooms (Nathan, 2006). Meanwhile, instructors face high enrollment classes, diverse student backgrounds, and underprepared students. Although active learning techniques are often cited for promoting higher-order thinking skills (Brookhart, 2010; Freeman, Eddy, McDonough, Okoroafor, Jordt, & Wenderoth, 2014), “the lecture” often prevails as the primary mode of instruction because of its adaptability to the typical structure of courses at most institutions and the views of instructors in how to teach. Innovative instructional strategies and effective technology integration can help faculty provide an active and engaging learning environment, even under the challenges of high enrollment, different learner characteristics, and high school students who are not ready for college-level performance.

The flipped classroom teaching strategy assists instructors to provide active learning opportunities for students by increasing their participation, taking responsibility for doing the online work, and asking for assistance (Ogden & Shambaugh, 2016). Few formal, longitudinal, and comprehensive studies exist on this pedagogy. Preliminary results from a number of studies have indicated positive results. For example, instructors at one university chose to implement pre-existing video lectures into one of their engineering courses (Azedevo, 2012). After watching videos at home, students were expected to apply the knowledge gained from the videos by participating in discussions and activities in class. Preliminary