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Flipping out about the flip: All hype or is there hope?

Lauren Calimeris[a,*], Katherine M. Sauer[b]

[a] Department of Economics, St. John Fisher College, 3690 East Avenue, Kearney 417, Rochester, NY 14618-3597, USA
[b] University of Colorado, 1800 Grant St., Suite 400, Denver, CO 80203, USA

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ABSTRACT

The flipped classroom was founded on student-centered pedagogy, with the idea that students retain more information by using active learning techniques during class compared to sitting in a lecture-based course. We implement a randomized experiment to quantify the effect of flipping on the learning outcomes of economics students. We compare standardized exam scores of students who experienced a flipped classroom to those who experienced a traditional classroom in principles of microeconomics courses. OLS regression results show that, following a negative adjustment period, students who experienced the flipped classroom scored significantly higher on midterm and final exams than did the control group. The magnitude of these effects suggests improvements in the students' scores of a lower bound of two-thirds to an entire a letter grade.

1. Introduction

While student-centered learning is gaining in popularity, undergraduate economics courses are still widely taught in the lecture format. Some instructors do attempt to incorporate active learning in their classes; however, these activities are limited due to the amount of content that must be covered (Hughes, 2012). Additionally, students most often need the instructor's expertise when trying to apply knowledge to problems or homework assignments, when the instructor typically is not around (Bergmann and Sams, 2012a,b). One solution to this problem is the "flipped" or "inverted" classroom. Flipping a class means the activities that traditionally take place in the classroom, such as lecture, are experienced outside of the classroom while activities that usually take place outside of the classroom now take place inside of it (Bergmann and Sams, 2012b; Hughes, 2012). Flipping a class is more than simply shuffling activities; this method is founded on student-centered pedagogy and employs active learning techniques during class time.

While there is no one formula for how to design and implement a flipped course and all flipped courses may look different, there are a few commonalities. In a flipped class, instructors typically break down lectures into modular components and create, or find, videos up to 20 min in length (Bergmann and Sams, 2012b; Hughes, 2012). Students watch these videos outside of the classroom on their own time. Proponents claim it enables students to learn new content at their own pace, allowing them to watch, pause, or re-watch lecture videos as necessary (Bergmann and Sams, 2012b; Talbert, 2012). Students may be assigned an activity to complete as evidence of watching the videos (e.g., worksheet, notes outline,

* Corresponding author. Fax: +585 899 3757.
E-mail addresses: lcalimeris@sjfc.edu (L. Calimeris), dr.katherine.sauer@gmail.com (K.M. Sauer).

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online quiz). In class, instructors may use Just-in-Time Teaching[1] techniques to address confusion students have with material encountered prior to class. The instructor may have students post online, email in advance, or bring questions with them to class. After a few minutes of discussion, activities such as problem solving, group work, discussions, simulations, or experiments may take place.

Learner-centered teaching has its roots in Piaget's cognitive theory (1967) and Vygotsky's zone of proximal development (Vygotsky, 1978). In the economics discipline, there is strong evidence to support the learning benefits of many kinds of active learning techniques. The International Handbook on Teaching and Learning Economics (2012), edited by Hoyt and McGoldrick (2012), meticulously documents the research and best practices for teaching with case studies, context-rich problems, cooperative learning, discussions, classroom experiments, interactive lecture demonstrations, and Just-in-Time Teaching techniques, all within the economics discipline. This book is a comprehensive guide to research-based best practices in teaching undergraduate economics. The *Starting Point: Teaching and Learning Economics* website is a free resource that "provides a comprehensive array of research-based instructional strategies aimed at promoting student learning in economics" (Starting Point, 2014).

Recent published studies attempt to quantify the effects of flipping on student learning outcomes; however, there is significant room for improvement in the rigor of both experiment design and analysis.[2] Pierce and Fox (2012), for example, flipped one set of topics in a pharmacy class. Using a *t* test, they conclude that students who experienced the topics in a flipped manner scored higher on the corresponding exam questions than students from the previous semester; demographic controls and regression analysis were not used. Larson and Yamamoto (2013) compare a fully-flipped spreadsheet skills course with a control course from a previous semester and analyze homework scores with in-class scores of the same problems. Using a *t* test, they find no significant difference in scores; demographic controls and regression analysis were not used. Moravec et al. (2010) employ a "learn before lecture" technique for several topics in a biology class. They compare the number of students in two fall 2009 treatment classes correctly answering certain exam questions with the number of students in two control classes during both fall 2007 and fall 2008. Using Fisher's exact test, they conclude that there is a 21% increase in mean performance scores on the five exam questions related to the "learn before lecture" treatment material. This result is likely overstated because students in the treatment class who did not complete one of the preparation assignments were dropped from the analysis. Findlay-Thompson and Mombourquette (2014) flip an introductory business course and compare student outcomes on exams, quizzes, and other assignments from that class with outcomes from students in two control classes during the same semester in 2012. Using descriptive statistics, they find no significant difference between the student outcomes in the flipped and traditional classes.

Given the paucity of a thorough quantitative analysis of flipped courses, this paper attempts to quantify the educational benefits of flipping the class in an introductory economics course at a small, private college based in the liberal arts tradition. We randomly assigned two sections of introductory microeconomics to comparison and treatment groups. The same instructor taught both groups, and there were no meaningful significant observable differences between academic and demographic characteristics between the two sections. We use standardized student exam scores on two midterms and the final exam to determine the effect of teaching methods on student outcomes.

Using ordinary least squares and controlling for demographics and academic achievement, results indicate that students in the flipped classroom scored significantly better on the second midterm and final exam compared to students in the traditional class. Flipping the class was associated with increases on standardized test scores of roughly 0.57–0.64 standard deviations compared to students in the traditionally taught class. This translates to a lower bound of an increase of roughly two-thirds to an entire letter grade. In surveys of student perceptions, students generally responded favorably to the flipped class structure.

The rest of this paper proceeds as follows: we first explain the methodology and then describe the model. We next discuss the the regression results and qualitative analysis of student perceptions. Finally, we present a discussion of the limitations of this study before concluding.

2. Methods

2.1. Experimental design

During the Fall 2013 semester, the instructor taught two 55-min sections of introductory microeconomics back to back at 9:05 am and 10:10 am on Mondays, Wednesdays, and Fridays in the same classroom.[3] Students enrolling in the two courses did not know of any differences between the courses except for the time slot. Using a simple coin toss, we randomly assigned the sections to comparison and treatment groups. The flipped course is considered the treatment group, while the traditional

[1] Just-in-time teaching is a method that entails students completing online assignments that the teacher reviews just before class (i.e., "just in time") so s/he can adjust that day's material to address student-learning needs.

[2] We restrict our search to articles published in peer-reviewed journals and exclude conference proceedings, since those manuscripts may still be in progress and the results not finalized.

[3] The classroom was a tiered classroom with a capacity for 40 students. The students sat in cushioned chairs with wheels, and the classroom was better suited for a lecture class as students did not have their own desks which they could maneuver for activities, making rearranging the room for experiments and demonstrations difficult.