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The impact of the flipped classroom in a principles of microeconomics course: evidence from a quasi-experiment with two flipped classroom designs

Chiara Lombardini[a,*], Minna Lakkala[b], Hanni Muukkonen[c]

[a] Department of Economics and Management, Faculty of Agriculture and Forestry, P.O. Box 27 (Latokartanonkaari 5), 00014 University of Helsinki, Finland

[b] Faculty of Educational Sciences, P.O. Box 9 (Siltavuorenpenger 1A), 00014 University of Helsinki, Finland

[c] Faculty of Education, University of Oulu, P.O. Box 2000, 90014, Finland

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ABSTRACT

This study uses a quasi-experimental, non-equivalent group design to analyze the outcomes in terms of students' learning and satisfaction of the redesign of a first-year, principles of microeconomics course from a lecture-based course using active learning techniques in 2013 to a partial flipped classroom in 2014 and a full flipped classroom in 2015.

Students perceived a higher degree of achievement of the learning goals in both flipped courses compared to the non-flipped active learning course. Moreover, participating in the partial or full flipped classroom decreased the odds of a D or F grade or of withdraw. However, only the partial flip was associated with overall better learning outcomes in the final exam, while there was no statistically significant difference between the non-flipped active learning course and the full flip. Age was negatively associated with learning outcomes and increased the odds of a D or F grade or of withdraw. Gender had no statistically significant impact on learning outcomes. Students were least satisfied with the full flip and equally satisfied with the non-flipped active learning course and the partial flip. Lower satisfaction appears to be due to increased workload, which students evaluated to be highest in the full flip, as well as to elements of group work design. In the flipped classroom design, the pre-class multiple choice tests on Moodle emerged as a clear favorite in students' teaching evaluations.

1. Introduction

In economics teaching, traditional lecturing still takes up the largest share of class time, an estimated 60% (Goffe and Kauper, 2014) to 83% (Watts and Schaur, 2011). This central role of lecturing is under increasing scrutiny as empirical evidence suggests that active learning techniques are more effective than lecturing in promoting learning (see e.g. Freeman et al., 2014).

A pedagogical approach that decreases lecturing, thus freeing class time for active learning, is the inverted classroom (Lage et al., 2000) or the classroom flip (Baker, 2000), whereby first exposure to the material is moved outside the classroom usually in the form of lecture videos (Abeysekera and Dawson, 2015). The classroom flip appears to improve learning outcomes as reported in three major reviews of the existing literature (Bishop and Verleger, 2013, Giannakos et al., 2014, O'Flaherty and Phillips, 2015, O'Flaherty et al., 2015) even though reviewers express some concern for the lack of a "*robust scientific approach*" in evaluating these learning outcomes (O'Flaherty and Phillips,

* Corresponding author at: Department of Economics and Management, Faculty of Agriculture and Forestry, P.O. Box 27 (Latokartanonkaari 5), 00014 University of Helsinki, Finland.

E-mail addresses: chiara.lombardini@helsinki.fi (C. Lombardini), minna.lakkala@helsinki.fi (M. Lakkala), hanni.muukkonen@oulu.fi (H. Muukkonen).

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2015, 89). Recent studies using more robust methods, seem to confirm the existence of improvement in learning outcomes from flipping the classroom, albeit moderate (Anderson and Brennan, 2015, Calimeris and Sauer, 2015).

Moving beyond the analysis of how flipping the classroom affects learning outcomes overall, some researchers have begun to investigate more fine-grained questions. Ryan and Reid (2016) asked how flipping the classroom affects the outcomes of weaker students. They found a 56% reduction in Ds and Fs grades and in the withdrawal rate when flipping the classroom even though no improvements in learning emerged at the aggregate level. Touchton (2015) focused on what type of learning flipping affects the most. He found a larger improvement in learning outcomes in the sections which students generally find most challenging even though at the aggregate level the improvements were very small. Olitsky and Cosgrove (2016) examined whether gains in learning outcomes become larger as students adapted to the flip and showed that this was the case: the gains in learning increased as the flipped course progressed and students became better acquainted with the approach. Jensen et al. (2015) raised the question of how much the impact of the flipped classroom on learning outcomes depends on the choice of the control against which the learning outcomes of the flip are evaluated. They found insignificant learning benefits of the flipped classroom compared with a non-flipped, active learning course.

On the costs of flipping the classroom, little is said in the literature. Olitsky and Cosgrove (2016) suggested that blended classroom flips can help save resources with no negative impacts on learning compared to a moderately blended class because they allow to decrease face-to-face class time. However, they did not take into account the extra time needed to develop the course online materials such as video lectures. McPherson and Bacow (2015), on the other hand, argued that flipping the classroom is most unlikely to help reduce costs as in current "traditional courses" lectures are relatively cheap while the major costs come from the staff and physical space needed for the discussion sections and laboratories. They suggested that one could obtain real savings if face-to-face discussion sessions, not lectures, could be substituted with interactive sessions run by technology

In this study, we further explore the questions raised by Jensen et al. (2015) and Ryan and Reid (2016) and compare the outcomes a lecture-based microeconomics principles course which makes use of active learning techniques with two flipped course designs. We examine the following main research questions:

1. How did the two flipped course designs impact the learning outcomes and likelihood of a D or F grade or withdraw compared to the non-flipped active learning course?
2. How did the two flipped course designs impact students' perceived learning and teaching evaluations (satisfaction, workload, perceived difficulty) compared to the non-flipped active learning course?

We use linear multiple regression and binary logistic regression models as well a non-parametric statistics to examine these impacts. The costs of inverting the classroom is also briefly discussed. The courses' re-design as a flipped classroom and the related learning outcomes are analyzed following the research-based design approach (Edelson, 2002). Design-based research integrates empirical educational research with theory-driven design of learning settings. If focuses on how to implement pedagogical practices in authentic educational contexts, and simultaneously develop new theoretical insights (Design-Based Research Collective, 2003). Typical for design-based research is to include successive and iterative phases of research and design: the design of educational settings is based on prior models and theories and results are used to develop both theories and successive implementations of the pedagogical methods (Design-Based Research Collective, 2003; Cobb et al., 2003, Cobb et al., 2015). In practice, the course objectives, implementation, and assessment are developed in an iterative fashion through the refinement of pedagogical design and the collection of empirical evidence on learning outcomes. The remainder of this article is organized as follows. Section two describes the materials and methods. Section three presents the results while section four discusses the results and concludes.

2. Materials and methods

2.1. The non-flipped active learning and flipped classroom course designs

The flipped classroom was developed from the non-flipped, active learning microeconomics section of a principles of economics course with 157 students enrolled taught in 2013. The non-flipped, active learning course included both micro- and macroeconomics and lasted for a semester. The microeconomics section of the course ended with a midterm exam. It included thirteen 90-min' classes bi-weekly in the first period of the fall term for a total of 13 class meetings. Approximately two thirds of class time was devoted to lecturing and one third to active learning such as think-pair-share and clicker questions. Continuous exposition by the lecturer was interspersed with active learning tasks so that uninterrupted lecturing did not exceed segments of 20–25 min. Students had to hand in three exercise sets as post-class assignments. There were no pre-class assignments. Students were provided with PowerPoint lecture notes which closely followed the textbook, Mankiw's and Taylor's Economics.

In 2014, the principle of economics course (N = 146) was split into two separate courses: principles of microeconomics and principles of macroeconomics. The former was redesigned as a flipped classroom without any changes to the amount of hours of in-class instruction, the learning objectives, the schedule, the topics and their order of presentation, the textbook, and PowerPoint slides. Lectures were moved outside class and offered on Moodle as lecture videos of length varying from 4 to 12 min. The lecture videos, produced by the instructor, followed closely the lecturing done in class in previous year. Students were required to prepare for class by watching the videos and/or reading the corresponding chapters in the textbook and then answering a multiple-choice test on Moodle. For a passing grade, students had to answer at least seven out of ten Moodle tests with a score of at least 80% right answers. The Moodle test could be repeated up to four times before the deadline. Students were strongly encouraged to post any queries about the video-lecturers and the Moodle tests on a discussion board to be then addressed in class.