

Learning Gain and Confidence Gain as Metrics for Pedagogical Effectiveness: an empirical assessment within an active learning large-classroom environment (0297)

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Introduction

This paper details the most recent results of a research project aimed at investigating the concept of 'learning gain' as a measure of pedagogical effectiveness. In the first part of the paper we describe the principles of a teaching approach that combines self-assessment and Peer-Instruction (Mazur, 1997) to facilitate the creation of active learning environment for a large-class undergraduate module in Economics. In the second part of the paper we conceptualise our definitions of learning gain and confidence gain, and we operationalise them to develop an evidence-based evaluation of our teaching approach. In recent times, the international pedagogical debate has registered increasing interest in defining, measuring, and evaluating the impact of different pedagogical approaches on student learning. Whilst the Organisation for Economic and Social Development embraced the broader approach of 'assessment of learning outcomes' (OECD, 2014 and 2011), the American and British literature seems to focus more tightly on the concept of learning gain. Within this context, the debate tackles the validity of metrics based on student performance taken at distinct points in time over a student's educational journey (McGrath et al., 2015). However, while the debate on learning gain focusses predominantly on measures of student attainment, little attention has been devoted so far to other important dimensions of learning, such as student self-assessment skills (Taras, 2015; Henderson and Harper, 2009) and student self-efficacy (Bandura, 1977 and 1997; Pajares, 1996). We argue that students' ability to reflect on their performance and form positive beliefs on their educational experience represents an important catalyst to learning, and should also constitute a learning objective on its own right (Ritchie, 2016). For these reasons, we propose a teaching approach that aims at enhancing students' performance, as well as students' awareness about their own skills. Our teaching strategy relies on an active-learning approach, which combines formative quizzes, Peer-Instruction, and self-assessment components (Aricò and Watson, 2015). In practice, we devise an algorithm that alternates formative assessment questions, self-assessment questions, and Peer-instruction moments, in a sequence of learning cycles iterated over the duration of each session. Thus, using data collected in the classroom, we proceed to evaluate the impact of our teaching approach constructing two measures of learning: one related to attainment, and one related to self-efficacy and self-assessment skills. In previous research (Aricò and Watson, 2015) it was demonstrated that within our learning environment: (i) students develop good self-assessment skills, (ii) Peer-Instruction effectiveness is independent of student self-efficacy, and (iii) learning gains generated by Peer-Instruction are higher when students' preparedness is initially poorer. Building on these results, we enhance the pedagogical design devised by Aricò and Watson (2015) to investigate: (i) the patterns of correlation between learning gain and confidence gain, (ii) the synergy between Peer-Instruction and self-assessment, and (iii) the characteristics of the distribution of learning gain and confidence gain. Our first research objective aims to uncover whether higher learning gain and are associated to better self-assessment skills, and positive self-efficacy beliefs. Our second research objective assesses whether the development of good self-assessment skills affects Peer-Instruction outcomes.

Methodology

Our analysis stems from a rich dataset collected over the teaching of a First Year, year-long, undergraduate module in Introductory Economics in 2015-16. Complying with a sound ethical

framework, students are assigned a personal Student Response Systems (SRS) device. Which are employed to promote teacher-student interaction. Thus, our dataset tracks individual student responses over the whole duration of the module. The Introductory Economics module is characterised by a rich learning environment composed of lectures, small-group seminars, and large-group workshops, where the Peer-instruction and self-assessment pedagogies are implemented. Students are initially presented with learning material delivered through 'traditional' lectures. Following this, students participate in workshops where they are exposed to a number of multiple-choice formative assessment questions, and self-assessment questions. Through the aid of SRS, students interact with the teacher according to the following algorithm. Students: (i) give a first answer to a question, (ii) evaluate their performance for the answer just given, (iii) compare and discuss their answer with their peers, and (iv) give a second and final answer to the same question. The crucial innovation analysed in this paper consists of the addition of a further stage (v), where students re-iterate self-assessment, and reflect on their ability to tackle similar problems in the future. As a new learning cycle begins, the algorithm is repeated for a number of questions that varies between 8 and 10 per session, for a total of 8 sessions per year. To construct a measure of learning gain, we compute the difference between the proportions of correct responses to formative questions, as they were given before and after Peer-Instruction. To construct a measure of student confidence gain, we compute the difference between the proportion of confident statements at the beginning and at the end of each learning cycle. Thus, we explore the association pattern of learning gains and confidence gains, as well as the role played by self-assessment and Peer-Instruction. Our approach is quantitative, and relies on widely-used statistical techniques, such as regression analysis, and tests for contingency tables.

Preliminary results and implications of the study

As highlighted in previous research, preliminary analysis on the data collected confirms that the teaching methodology appraised in this paper generates good self-assessment outcomes. We identify three additional results: (i) As we evidence the interplay of two pedagogies, we uncover that the role played by self-assessment displays stronger association with learning, compared with Peer-Instruction.

(ii) Students who display a higher learning gain, also tend to experience higher confidence gain. (iii) However, a comparison of the distributions of gains, highlights that student confidence increases far more than student learning. While our first finding suggests that developing students' self-assessment skills generates a boosting effect to the standard Peer-Instruction algorithm, our second result confirms that positive learning experiences are associated to increased student self-efficacy. We interpret our third result by suggesting that, aside from the experiential learning elicited by Peer-Instruction, vicarious experiences, in the form of instructor's guidance and support, also play an important role in the formation of student self-efficacy beliefs. Further research will aim to explore the data at student-level to identify specific patterns of learning that are affected by student demographics.

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