Learning Gain and Confidence Gain Through Peer-instruction: the role of pedagogical design

Introduction

This paper discusses an empirical investigation to pilot and evaluate measures of learning gain (HEFCE, 2017) at the University of East Anglia (UEA). We focus on the 'Self-efficacy Assessments' strand of the UEA Project (Aricò *et al.*, 2017) to investigate the robustness of academic self-efficacy metrics to variations of the pedagogical design.

Academic self-efficacy (ASE) is defined as student confidence at performing defined academic tasks or achieving specific academic objectives (Bandura, 1977, 1997). Evidence from pedagogical research, and the educational psychology literature, demonstrates that students' ability to form positive ASE beliefs, represents an important catalyst to learning (Ritchie, 2016). Thus, we suggest that fostering ASE, and tracking its changes, represent a valuable approach to quantify the distance travelled by students over their academic journey (McGrath *et al.*, 2015).

We employ a well-established pedagogical framework, which combines peer-instruction (Mazur, 1997) with self-assessment, to promote active-learning in a large-class Introductory Macroeconomics module taught at UEA. We define learning gain as the difference in students' knowledge and skills before and after peer-instruction. Similarly, we construct a metric for 'confidence gain' by measuring the change in ASE levels during peer-instruction. Thus, we investigate the relationship between learning gain and confidence gain.

In previous research, we uncovered a consistently strong and positive association between learning gain and confidence gain (Aricò, 2016). However, we were not able to identify whether this association is robust to slight variations in the peer-instruction algorithm. To address this issue, we re-consider Bandura's (1977) seminal contribution, and his discussion of the role of *mastery of experiences*, and *vicarious experiences*. In a pedagogical context, the principle of mastery of experiences implies that an experiential learning approach (Kolb, 1984) –where students explore independently to develop new knowledge- is the most effective pedagogy to foster ASE. At the same time, according to the vicarious experiences principle, ASE can also be enhanced when students observe another agent, such as their teacher, demonstrating the use of a given body of knowledge (e.g. teacher showing students how to solve a problem).

In order to operationalise our research question, as well as the role of vicarious and mastery of experiences, we consider two variants of the peer-instruction algorithm. In the first (second) variant, students report their ASE levels before (after) receiving feedback from their teacher. According to our hypothesis, if the teacher plays an important role in the process of confidence-building in the classroom, a change in ASE should be significantly stronger in the second variant. Thus, we formulate two research questions: (i) Does teacher intervention impacts on the change in ASE? (ii) Is the relationship between learning gain and confidence gain robust to pedagogical design?

Methodology

We analyse a dataset collected over the teaching of a first year, year-long, undergraduate module in Introductory Macroeconomics in 2016-17. In compliance with a sound ethical framework, each

student enrolled in the module is assigned a personal Student Response System (SRS) device, which enables the teacher to conduct formative assessment quizzes, and track student performance. Students attend lectures, where the learning material is presented and explained. Following this, students participate in workshops, where they are exposed to a number of multiple-choice formative assessment and self-assessment questions. Through the aid of SRSs, 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 (peer-instruction), and (iv) give a second and final answer to the same question. At this point, under the 'Vicarious Experience Scenario' (VES): (v) the teacher reveals and explains the correct answer to the question, and (iv) students re-iterate self-assessment, and share a self-efficacy statement on their ability to tackle similar problems in the future. Alternatively, under the 'Mastery of Experience Scenario' (MES): (v) students first share their self-efficacy statement, and then (iv) the teacher reveals the correct answer to the question and provides an explanation. Under both scenarios, as a new learning-cycle begins, the algorithm is repeated for a number of questions that varies between 8-10 per session, for a total of 8 workshop sessions across the module. In order to generate evidence able to identify the role of the teacher on student self-efficacy, 4 sessions were conducted according to the VES scenario, and 4 sessions were conducted according to the MES scenario, alternating one VES and one MES session. 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. At the same time, to construct a measure of student confidence gain, we compute the difference between the proportion of high self-efficacy statements, as given at the beginning and at the end of each learning cycle. Thus, we employ parametric and non-parametric statistical techniques to assess: (i) whether the size of the change in ASE levels differs across the VES and the MES scenarios, and (ii) whether there is positive association between learning gain and confidence gain in either, or both, the VES and MES scenarios.

Preliminary results

A preliminary analysis of the dataset highlights that confidence gain is significantly higher under the VES scenario, confirming that the teacher's intervention does interact with the peer-instruction pedagogy, and displays a strong effect in the formation of ASE beliefs. Differently from the results obtained for the 2015-16 cohort (Aricò 2016), we also find that learning gain and confidence gain no longer display positive association, either in the VES, or in the MES scenarios. We conclude that pedagogical design displays a strong influence on the determination of confidence gain, and on the relationship between learning gain and confidence gain. Since the evaluation of affective measures of learning gain, such as ASE, are rolled and implemented across different disciplines at UEA and beyond, these results are very valuable. Establishing an accurate and uniform pedagogical design, which maximises students' learning in all its dimensions, appears to be an essential requirement for meaningful comparisons across metrics for learning gain.

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