Medium-Term Effects of Active Learning

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Abstract. We have divided a student cohort into two parallel teaching settings. One group of students was part of a highly interactive SCALE-UP setting, whereas the remaining students were taught in a lecture. Within the 14-week teaching period, we compared students' performance in both settings and could draw conclusions on immediate performance differences. Eight months after the teaching, all students had to sit a high-stakes final exam, including the topics of the lecture. In this poster presentation, we relate the final exam results to the former performance results and draw conclusions on medium-term effects based on the two teaching settings.

1 Background and Study Design

In spring 2017, we have divided a non-physics undergraduate student cohort into two parallel teaching settings. We offered a highly interactive flipped class (SCALE-UP) [1] to one group of 52 students and a reformed LECTURE to the remaining 318 students.

The students in the SCALE-UP setting worked through different activities in small groups of 3-4 students each. Before each class, students started learning about a topic by doing assigned readings and online exercises via Mastering Physics [2]. In class, the SCALE-UP students did activities that helped them understand the basic concepts from the home reading, and they applied these concepts in hands-on experiments and problems. Lecturing was reduced to a bare minimum.

Apart from content delivery, the LECTURE setting included 40 demonstrations. A total of 37 conceptual clicker questions within a Peer Instruction environment engaged the lecture students interactively and provided immediate feedback to the instructor regarding their level of understanding.

The teaching period for the experimental setting extended over 14 weeks with three weekly contact hours. An additional weekly recitation session (1 hour) allowed students from both settings to discuss numerical problems in groups (15-25 students) together with teaching assistants.

To assess the performance related to the experimental setting, we recorded the performance of the student cohort at different points in time (Fig. 1):

- Force Concept Inventory (FCI) Pre-test: first week of lecture
- Physics Mid-term exam: 10^{th} week of lecture
- Force Concept Inventory (FCI) Post-test: 14^{th} week of lecture
- Math (calculus) Exam: 3 months after the last lecture (as a secondary control variable)
- Physics Final Exam: 8 months after the last lecture

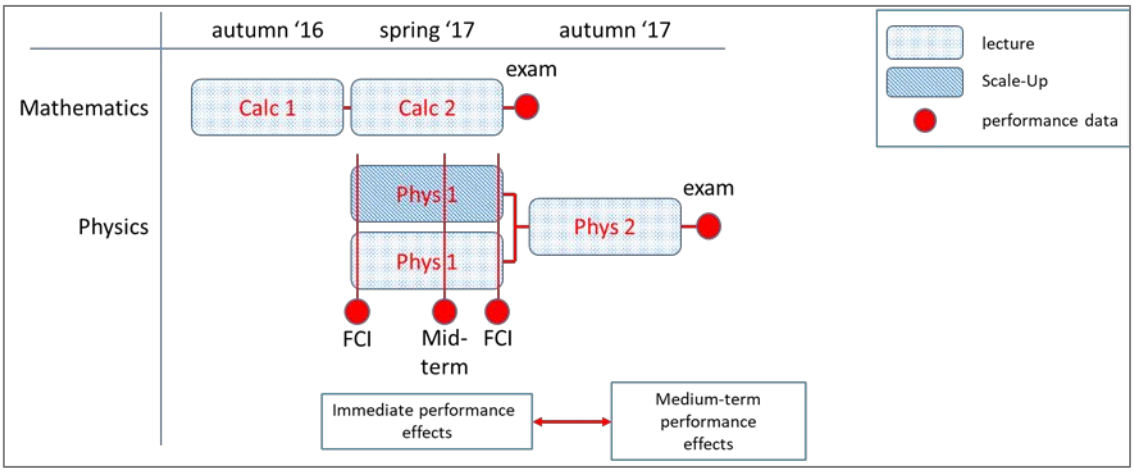

Fig. 1 Longitudinal Performance Assessment of the Student Cohort

2 Research Questions and Implications

Short-term effects, based on the outcome of the mid-term exam, revealed that the conceptual gains were stronger for students in the active-learning setting, but that the problem-solving (numerical) performance of both groups was similar [3].

While taking into account the outcomes of the final exam, we are now able to evaluate if and how these differences persist over a longer period. Preliminary results offer evidence that the positive effects of active learning are still visible after eight months. We will present those and further medium-term effects in our poster presentation.

Within the large body of physics research, equivalent studies were mostly carried out in the last decades of the 20th century and they compared traditional direct instruction to reformed lectures [4]. Our study supports the discussion on the benefits of active-learning environments in two different ways:

- We contrast a modern (reformed) lecture with a collaborative interactive small-group setting such as SCALE-UP.
- We offer evidence on persistence of active-learning gains over a medium-term time scale.

References

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