Authors
Prof. Dr Andreas Vaterlaus, D-PHYS, Laboratory for Solid State Physics
Prof. Gerald Feldman, former guest professor at D-PHYS
Dr Guillaume Schiltz, D-PHYS, Educational Developer

Flipping large university courses: How do student learning gains improve compared to lectures?

We have split a student cohort into two parallel settings, a flipped learning group and a lecture group. Comparing the performance results of both groups we can draw conclusions on immediate and medium-term learning effects.

Introduction

In the past, all ETH introductory physics lectures have been reformed and supplemented by active learning elements such as Peer Instruction 1. A different approach consists of breaking up large lectures into smaller classes and shifting to highly interactive flipped learning settings. Studio Physics and SCALE-UP are well-documented implementations of this approach 2. Running multiple parallel classes, however, implies substantial investment efforts (rooms, faculty) 3 and it is advisable to gain insights on expected learning improvements before deciding on either reformed lectures or small interactive class settings. A comparative study of student achievements between these two different settings is needed in order to guide pedagogical decisions going forward. For this reason, we have conducted a pilot study within a physics lecture class of 370 students.

Teaching concept

In a one-year undergraduate physics course, we divided the student cohort into two parallel teaching settings. During one semester, we offered a highly interactive flipped SCALE-UP environment to one group of 52 students and a reformed lecture to the remaining 318 students. In the following semester, all students were taught in the same lecture setting without a SCALE-UP alternative. Within the 14-week parallel teaching period, we compared students' performance in both settings and could draw conclusions on immediate differences. Eight months after the SCALE-UP intervention, all students had to sit the same high-stakes final exam, which consisted of topics throughout the entire year, including topics from the previous intervention. We related the final exam results to the former performance results and gained insights on medium-term effects based on the two teaching settings. In addition, we analysed student feedback that included data related to class attendance, out-of-class preparation, level of intellectual challenge, and other items.

Analysis of student learning

- During the intervention period, students from the flipped SCALE-UP group outperformed students from the lecture setting. This performance gain, however, was substantially reduced when evaluated over the medium-term scale.
- For those students who participated in the 14-week flipped SCALE-UP group, we could not identify any transfer or modification of learning behaviour that would induce better performance outside of a dedicated flipped learning setting.

- Compared to the lecture students, students from the flipped SCALE-UP group did not invest more overall study time, even though they had to come prepared to class.
- The SCALE-UP students manifested an increased level of self-confidence in their own learning achievements.

Lessons learnt

- A single active learning intervention of one semester (14 weeks) is too short to sustain substantial performance gains.
- Even though students enjoyed the flipped class very much, their performance gains were much lower than those reported from the (mainly U.S.) literature.
- Curricular constraints such as contact hours and assessment conditions should be considered and adapted when shifting to a flipped class setting.

References

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