How can we optimize laboratory based practice time via flipped classroom and multimedia resources?

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Abstract. To maximize laboratory-based practice time in an undergraduate course at the School of Engineering, which was limited due to the number of students, the theoretical topics were transferred to a flipped classroom format, via the production of explicative videos. Preliminary results show that videos achieve the objectives being well accepted by the students.

1 Motivation

Because of the high number of students (300-400 by semester) in engineering undergraduate laboratory-based courses in UdelaR School of Engineering, the subgroups of 15 students only manage to get six face to face three-hour tutorials in each semester of the second year of the career. Since this time is not sufficient for the students to learn basic principles of experimental work and data analysis techniques, nor to practice teamwork, it is also depriving previous and post lecture reflexion about the tasks. It hinders the acquisition of paramount skills such as critical thinking, communication and documentation.

Under the project Innovation in Education, Open Educational Resources A Twist in Teaching, different area experts worked together in order to design and convey multimedia resources applying ICT in education. We intend to maximize laboratory-based practice time and reduce lecture time, devoting class time to tasks where students can develop measuring and data analysis techniques. The syllabus primordial concepts were taken into consideration to shape the workflow and identify the activities which could be transformed into flipped classroom format. Teachers used to employ 30 to 40 minutes to explain the theoretical concepts needed during the class. The change allows the student to get to class ready for laboratory practice tasks. Even though written theoretical material has always been available, individuals with different kind of learning strategies could benefit from a multimedia format.

2 Development and implementation of videos and flipped classroom.

According to Cognitive Load Theory [1] and Scaffolding Complex Learning [2] individuals find it easier to understand complex concepts once the basic ones are settled. This is why we believe further analysis will enable to show students successfully complete advanced tasks. Flipped Classroom [3] enhances the probability of this to happen. The methods to evaluate this thesis include peer correction, Moodle quizzes and interactive questions using moodle plugins such as H5P. These are part of the new syllabus which includes video for primal concepts.

The most difficult topics on the syllabus were identified as those related to data processing. For each one of the topics, one or two videos were produced explaining the basics. Complementary off class study, written material, and the laboratory based practice, should provide the students with a learning route from basic to advanced.

Undergraduate courses of Engineering at UdelaR, have a long tradition to be part of an open educational resource where recorded classes are open to watch online [4]. OpenFIng is widely used and embraced by students. The way to include the different videos within the

curricula presented a series of challenges. First, to write in an appropriate way the scripts, and understanding the professors' and student's perspective from an audiovisual point of view. One of the most difficult tasks was to find visual examples to clarify the concepts. The metaphors used to illustrate main concepts such as graphic representation of random variables or significant digits [5] allow to deal in a better way with lecture times in order to take advantage of the laboratory based practice. For instance, based on Herber's paper [6] we figured out a way to represent discrete random variables visually (Fig. 1a). The collaboration of professors and voluntary students made possible to film a human scale histogram with a great visual impact (Fig. 1b).

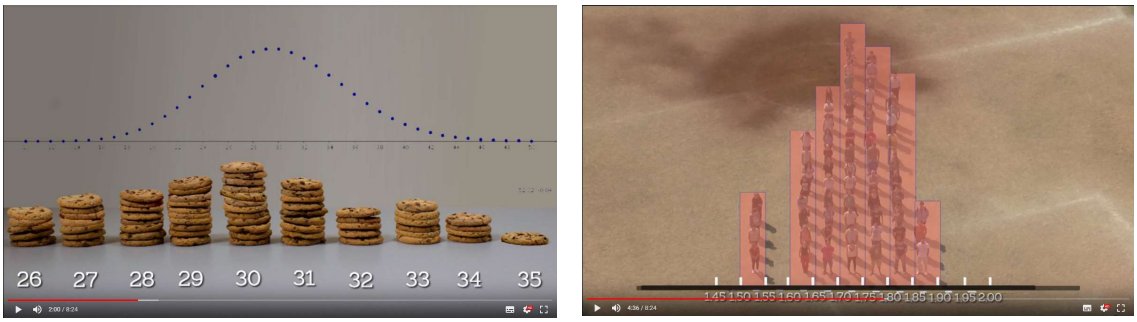

Figure 1 a) Graphing Discrete Random Variables, b) Graphing Continuous Random Variables [4]

3 Conclusion

This research allows to evaluate two approaches where students acquire knowledge both prior and after watching the video. Group interviews and surveys to those who watched the video afterwards probe to us the concepts where stated clearly. The students to watch the video after the class having already been given tools and instructions. The implementation will allow a more profound evaluation. The creation of the videos enhanced the possibility of maximizing the laboratory based practice time, enabling the syllabus to adapt to the flagging concepts.

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