University course in experimental physics at home: possibilities and practices

Abstract. In this work we report the implementation of an experimental physics course in emergency distance education format. The structure used for the course is presented and a theoretical framework clarifies the engagement aspects of the course, marked by digital inequality in a developing country.

1 Introduction

The COVID-19 pandemic have accelerated the remote education in all levels, worldwide [1]. The so-called emergency remote education (ERE) became for the past 1½ years the mainstream of educational systems in several countries. Specially for developing countries, that made explicit students' digital inequality and the lack of proper institutions infrastructure [2], affecting attempts to keep educational systems to keep running during the pandemic.

At university level, ERE brought up challenging demands of all sorts. Regarding experimental physics courses, adaptations for implementing ERE format required have been reported [3]. In ERE format students faced the need for setting up at home activities and experiments that would be traditionally set in physics lab. Considering those who were earning teaching credentials in physics, another aspect became salient: beyond to set up sort of a lab at home, the whole idea of physics concepts learning through experiments demanded a reconsideration.

In this work our aim is to report and analyze solutions for an experimental physics course in a public university in Brazil under ERE format, contrasting possibilities caveats implicated in this approach.

2 Conceptual framework

In the experiments, we followed problem-solving structure [4] and we set the activities oriented by the team-based approach recently brought to physics education [5]. Also, in order to make the the experiments engaging for students, we draw on engagement theory [6], offering in each experiment (*i*) a clear set of rules, orienting students; (*ii*) room for self expression, as students could adapt their experimental setup and (*iii*) allowing students to have enough feedback for keep tracking their own progress.

3 Teaching and learning structure and context

The Experimental Physics I course was conducted by 4 university professors with nearly 100 grad students attending it each semester. It mixes synchronic/a-synchronic activities. Students were encouraged to use material that can be found in daily activities (Fig. 1). Six experiments on classic mechanics were proposed, varying from newton's second law to motion under drag forces. Working in groups of three, students are furnished with previous instructions videos, advising on experiments assembly and about data collecting and analysis. Then, students toke a set of conceptual tests on the physics specific content regarding the experiment. After that they are suggested to gather the material for assembling the experiment.

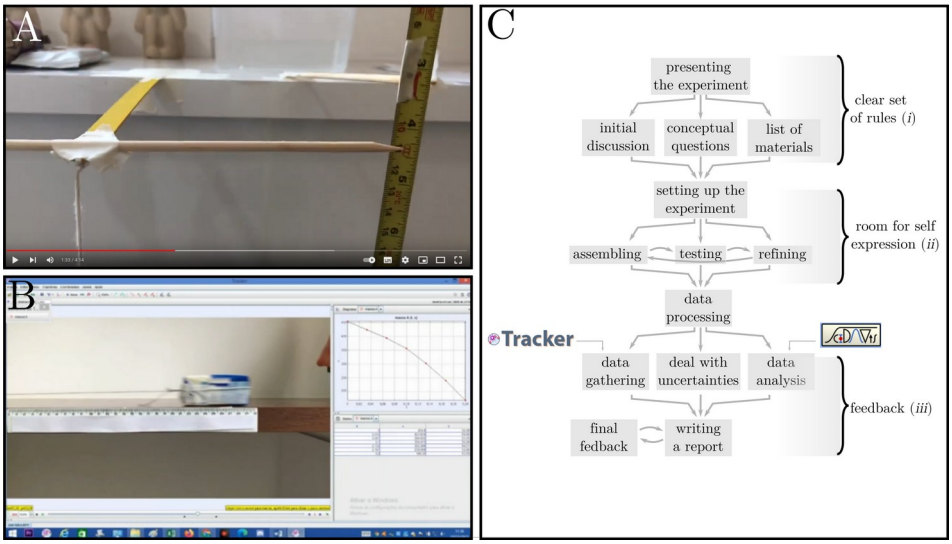

Figure 01: (A) example of experiment instructions; (B) usage of video analysis for data gathering; and (C) structure of the course and its relations to the engagement aspects.

Thus, they perform the data collection for proceeding the analysis which ends up in a scientific-like report. Students lacking the technical apparatus (like not having a computer, a smartphone or so) got from university a budget of 1½ Brazilian minimum wage overcoming digital inequality [7].

4 Final Considerations

The ERE experience in experimental physics changed deeply the teaching dynamic in the physics department. With nearly a hundred students finishing the course during the 2021/1 semester and another hundred enrolled for the 2021/2, it can be said that structuring the course for proceeding experiments at home helped to overcome some of the challenges COVID-19 pandemic have imposed. As pandemic is still on, ERE format may be the only way to go, even in experimental physics coursed. Our approach showed (a) it is feasible to proceed a lab course at home; (b) experiments must be adapted for that; (c) minimizing the digital inequality is mandatory and (d) although difficulties on specific content seems to be the same as *in loco* lab classes, by providing cycles of online feedback, students had more opportunity to overcome their obstacles.

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