

Using Smartphone Sensors for Virtual Labs during COVID-19 Era

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INTRODUCTION

- Spread of COVID-19 impacted “hands on” laboratory science courses. We wanted to design experiments for first year college students that could be done from their homes/dorms with their smartphones to be able to teach physics concepts virtually
- Specifically, these activities intended to explore the acceleration due to gravity (little g) using an accelerometer built into their smartphones.

METHODS

- Students were asked to design a setup in which they could drop their phones a distance of 1m to take some measurements using the physics toolbox sensor app, analyze their data, and plot their results



Figure 1: This is a setup by one of the students. The distance is marked 1m in this photo. We asked the students to repeat their calculation at least 5 times. Student's could use the “measure” App on their phone to measure 1 m.

- The next lab the students would do required them to turn their smartphones into pendulums. We carried out an analysis to test the students' understanding of what influences the period of a pendulum before and after a short lecture was given to them by the REU student during class.

RESULTS

What do you think influences the period of a pendulum?

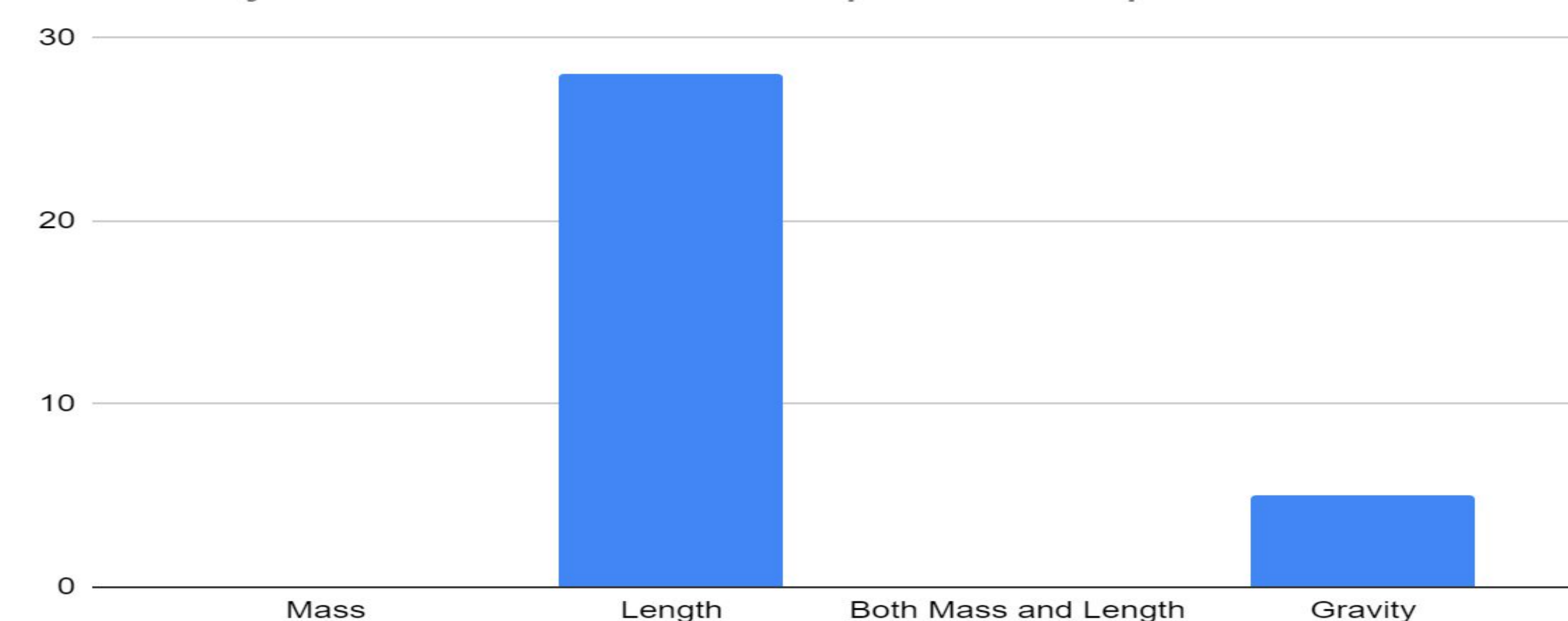


Figure 2: An overwhelming majority of the class was already on the right track. Pendulums and the way they work are a great way to introduce students to the concept of simple harmonic motion, and many of them seemed to understand this as this course was designed for engineering majors

What happens to T if g is decreased by a factor of $1/4$ th?

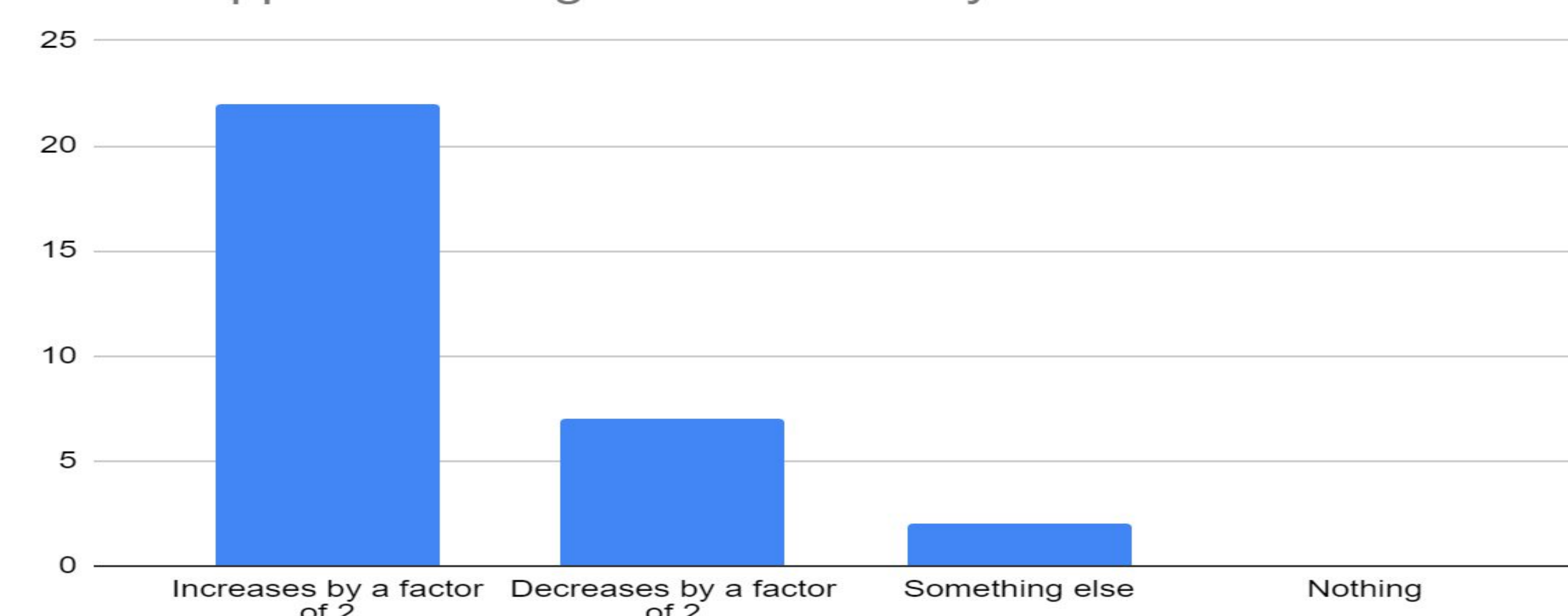


Figure 3: The next question asked students to apply their understanding about the mechanics of a pendulum, after having been given a lecture which derived the equation of the period of a pendulum. A worked example was described as part of the lecture showing how to analyse changes in one parameter on another.

Summary and Future Work

- Around 70% of the students seemed to understand the inverse proportionality between the period of a pendulum and the acceleration due to gravity
- All of them understood that the mass of a pendulum does not influence its period
- Students will be asked to think about any differences between their results for g from individual trials and from the two different methods they used
- They will explore error and uncertainties that arise when conducting experiments
- Since they conducted these experiments independently and as a part of small groups, they will be able to compare their calculations

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References

1. Moldwin, Mark B., (2018) Dorm Room Labs for Introductory Large-Lecture Science Classes for Non-science Majors, *Journal of College Science Teaching*, 47(5), pg. 36-41.
2. Physics toolbox sensor app developed by Vieyra Software <https://www.vieyrasoftware.net/>