

# Smartphone Lab work at University

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**Abstract.** *We implement a teaching unit in first year to teach students how to use the smartphone sensors in order to do experiments in optics, in acoustics and in mechanics at University. In this context, lab works with Smartphones have been carried out at the University of Bordeaux (France) in the first year with around 350 students. Most of these smartphone experiments were performed out of a lab. This new way to do physics experiments at University encourages us to develop a specific framework to perform this labwork. To conclude, we present students feedbacks about this teaching unit.*

## 1 Smartphone as a mobile lab

The Smartphone is an omnipresent device in students' everyday life. It is useful for logging on the Internet, finding information and communicating. However, in order to save batteries, adjust brightness, or improve ergonomics, Smartphones use very sophisticated and accurate sensors. For example, we can mention the use of accelerometers in order to rotate the smartphone screen. Hall Effect sensor is also used to detect the presence of a magnet located on the cover in order to deactivate the Smartphone when the cover is closed. Most smartphones have a wide range of sensors such as brightness sensor, magnetic field sensor, accelerometers, gyroscopes, camera, microphones, speakers...

From a scientific and a pedagogic point of view, those sensors allow us to carry very interesting experiments in High School and at University as done with 350 students in the first year of Bachelor Degree at University of Bordeaux. Using their smartphones in science allows students to learn Physics in their everyday lives with an entertaining approach. Smartphones become then a mobile laboratory for science, as already mentioned by others [1].

## 2 Smartphone based lab work

The smartphone-based teaching activities took place during a class in the first semester of bachelor degree in which many domains of Physics were introduced such as : Astrophysics, Nuclear Physics or Fluid Mechanics. In this class, at least three lab works with smartphones were done as a complement to lectures. Students had two weeks to carry the experiment they were assigned. The work had to be done in groups of 4 students in order to use teamwork skills and also to share smartphones. The lab work can be done everywhere : at home or at University and when students want, ... An openlab containing simple devices (such as timer, ruler, etc...) was accessible to everyone. Two Smartphones were available for students who did not have a smartphone or the sensors required for a specific experiment. In terms of pedagogic resources, students could use videos of experiments made for the MOOC "Physique des Objets du Quotidien" with its fifth week devoted to Smartphones and their use in science [2].

Between 3 and 5 smartphone lab work were proposed such as string resonance, Doppler effect, absorption law, for example. At the end of the teaching unit, students have to choose an extra topic they have to characterize and analyze with smartphone experiments. These extra work are presented in a special session at the end of the semester.



Fig. 1 Example of a smartphone experiment to estimate Doppler effect performed by students in 1<sup>st</sup> year.

### 3 Conclusion

Feedbacks from students show that the smartphone is a very good pedagogical device in order to experiment Physics. It allows students to use a device that they all have and it shows them how to do Physics, or experiments in Science in general, easily. Those experiments make students aware of the role and the accuracy of the sensors they use.

### References

- [1] Schwarz, Oliver, Patrik Vogt, and Jochen Kuhn. "Acoustic measurements of bouncing balls and the determination of gravitational acceleration." *The Physics Teacher* 51.5 (2013): 312-313.
- [2] MOOC Physique des Objets du Quotidien : <https://www.fun-mooc.fr/courses/course-v1:ubordeaux+28003+session03/about>