Physics in your Pocket
Smartphones and Physics Experiments
Abstract

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Abstract. Smartphones and tablets have become a learning tool in every discipline, but in physics teaching their use goes beyond their use as knowledge facilitators. Many works have proven how these devices can be successfully used in physics experiments. Mechanics, Atmospheric Physics, Fluids, Optics, Electromagnetism, Nuclear Physics, are fields for which teachers have implemented experiments that can be done with the smartphones' sensors or via video analysis using the smartphone. In this symposium, four groups will discuss some of their recent results, focusing on different aspects of this technique.

1 Introduction

During the last forty years, the use of computers in education has evolved from the use of in-site simple computer programs to web-shared contents, videos and simulations to anywhere and anytime mobile learning. In general, the use of mobile technologies is reshaping how we teach and learn, but physics teachers can also take advantage of the ever-increasing graphical and calculating capabilities of mobile devices as well as of their built-in sets of sensors. These sensors allow the students to use their own smartphones and tablets to do physical measurements in teaching laboratories and in everyday activities and to learn physics by observing and measuring nature by themselves.

In this symposium four groups will describe their work designing physics experiments with smartphones, developing apps to do physical measurements, analyzing learning results of the use of smartphomes.

2 Contributions

The work by Monteiro, Stari, and Martí, “Physics experiments using simultaneously several smartphone sensors”, discusses the possibility of using simultaneously different smartphone sensors in the same physics experiment to measure complementary magnitudes, as well as the advantage that such use means in simplifying experimental setups and reducing costs. In this work, some examples of experiments performed combining two sensors are described, as well as different activities that can be explored with them depending on the physics level of the students.

The second contribution in this symposium, “Mobile Devices as Experimental Tools: Five Empirical Studies on Student’s Learning in Mechanics”, by Klein, Becker, and Kuhn, gives an overview on the experimental possibilities of mobile devices in introductory mechanics courses by using smartphone sensors and video analysis. This work compares learning results of students who use and who don’t use mobile devices as experimental tools. The authors use an instructional approach to guide students through experimental activities, and investigate students’ learning, formulating hypotheses and research questions based on the theoretical and conceptual framework of multimedia learning [1].

Dorsel, Staacks, Stampfer, Hütz and Heinke, authors of the third contribution, “Smartphone Experiments beyond Newtonian Mechanics” discuss how non-mechanical experiments, that are usually less explored by physics teachers using smartphones, can be performed by adding to the smartphone other sensors via Bluetooth, as Bluetooth hardware, versatile sensor boxes or extensions based on the Arduino platform. These add-ons would allow the students to extend the magnitudes that can be measured with the smartphone, as can be distances to the smartphone, temperature or humidity. This work also describes how the app ‘PhyPhox’, developed by the authors, can be used remotely and transfer data via a Bluetooth connection in order to ease data acquisition in many experiments.

Finally, Buongiorno and Michelini describe a different approach to the use of smartphones in physics teaching. They proposed 17-19 y.o. high school students to analyze different apps and to design experiments on acoustics, mechanics, and spectroscopy. In this way, the authors proposed a transversal work in which the students not only would learn physics, but they would also acquire a working experience. The authors researched, between other questions, how the laboratory work activated scholastic knowledge and how it could play a role as a link between cultural and technical competences.

References

[1] R.E. Mayer Mayer, Cognitive theory of multimedia learning. In *The Cambridge Handbook of Multimedia Learning*. Cambridge University Press, 2014.