Symposium
Connecting research in physics education, curriculum decisions and teaching practices

Organized by GTG Physics Education Research at University-PERU
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Abstract. In the PERU symposium we deal about the physics education research and the consequences of its results for physics teaching. The symposium presents four different aspects of physics teaching and learning, but which have in common research-based problem analysis. All four proposals are based on rigorous problem analysis and standard methodology in PER. Thus, their conclusions are not just intuitive proposals based on teaching experience, but on careful planning of data collection, analysis of results, and evidence-based.

Introduction

Research results in any field, their transfer into practice is not necessarily straightforward. In the Girep Thematic Group PERU we work in an international cooperation effort to transfer the results of research in physics education to teachers and curriculum designers [1]. One of the principal objective of the Girep Thematic Group PERU is to share Physics Education Research results and its relevance to physics education and classroom practice. In particular, suggesting ways in which the facilities for the study of physics at introductory physics courses might be improved.

Since 2012 PERU thematic group has organized symposia in Conferences and Seminars, with the general objective of bringing together significant experiences and points of view from different areas of the world that are expressed in simple language, with the aim also of encouraging the application of innovative classroom practices and the implementation of research-based teaching initiatives. The results of the research suggest the presence of very different factors that influence the teaching of physics and that make this task complex. This rejects a simplistic conception of physics education that considers it a simple task that would consist of mastering the contents and having 'diplomacy' to deal with the students. On the contrary, as we will see in the symposium, the results that are accepted by the international community of physics teachers indicate that the task to be developed and the problems to be faced are sufficiently complex to constitute a field of research with multiple dimensions.

In the present symposium we deal about the physics education research and the consequences of its results for physics teaching. The symposium presents four different aspects of physics teaching and learning, but which have in common research-based problem analysis. All four proposals are based on rigorous problem analysis and standard methodology in PER. Thus, their conclusions are not just intuitive proposals based on teaching experience, but on careful planning of data collection, analysis of results, and evidence-based conclusions. The problems analyzed cover different aspects of the physics teaching-learning process. Innovative aspects such as the effect on learning of integrating engineering projects in the science teaching process (first presentation), the influence on the learning process of conceptions about science and attitudes (second presentation), and aspects related to the teaching content and learning difficulties of students (third and fourth presentations).

Recent studies suggest that the integration of engineering projects into science education, called STEM education, can support the learning of traditional science content and improve attendance and engagement. However, learning science content and practices through participation in engineering projects is not straightforward and requires scaffolded design. In the presentation "Learning Physics while Engaging in an Engineering Project" by Kapon et al. the possibilities and challenges of engaging students in engineering projects as a venue for learning physics at the advanced high school level are discussed.

In the last decades literature has shown that in addition to conceptual content, epistemological beliefs and attitudes play a relevant role in the physics learning process. The presentation "What are the differences in the attitudes and beliefs about science of students in the physics-mathematics and life sciences areas? and what are their impact on teaching? by Arturo C. Marti and colleagues compares the attitudes and beliefs about science at the beginning of their college careers using the CLASS (Colorado Learning Attitudes to Science Survey) tool of two groups of students: physical sciences and life sciences. Some of the possible causes of the differences found and their implications for teaching are discussed.

Difficulties in the use of mathematical concepts and formal reasoning are one of the major obstacles for students entering introductory physics courses in college. In the presentation "Test of Calculus and Vector in Mathematics and Physics: A research-based tool for improving the teaching and learning of physics in first-year courses", Ornella Pantano et al. present an assessment tool, called Test of Calculus and Vector in Mathematics and Physics (TCV-MP), which they have developed with the aim of comparing the ability of students to answer questions about derivatives, integrals and vectors in a purely mathematical context and in the context of physics. The usefulness of the tool for both students and teachers is discussed.

The last presentation focuses on one of the most traditional lines of research in PER, the research on the difficulties of students in understanding specific topics of the curriculum. In this case, the difficulties encountered by first-year university students in understanding the moment of inertia in the phenomena of rotation of a rigid body around a fixed axis are presented. An open-ended questionnaire is presented to first-year students in a calculus-based introductory physics course, and the results indicate that most of the students have persistent difficulties in understanding the concept related to non-scientific reasoning.

References

[1] Guisasola, J. (2019). Based Alternatives to Traditional Physics Teaching at University and College. In *Upgrading Physics Education to Meet the Needs of Society* (pp. 127-131). Springer, Cham.