USING RESEARCH-BASED INSTRUCTIONAL MATERIALS TO FOSTER CONCEPTUAL UNDERSTANDING: TUTORIALS IN INTRODUCTORY PHYSICS

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Research on the teaching and learning of physics has identified specific conceptual and reasoning difficulties that often prevent students from developing a functional understanding of various topics taught in introductory physics courses. There is evidence that instructional materials that take into account such difficulties and prompt students to critically assess their own understanding can improve student learning.

This workshop will introduce participants to Tutorials in Introductory Physics [1] a set of materials intended to supplement the lecture, textbook, and laboratory of standard introductory physics courses for students in physics, engineering, and other fields. The *Tutorials* consist of cooperative-group worksheets to be used in synchronous (face-to-face or online) teaching environments and corresponding homework tasks. Each worksheet is preceded by a pretest that assesses students' prior knowledge and understanding about the respective topic. Instructors' materials also include notes on aspects that students may find particularly challenging as well as sample examination questions to assess student learning.

The *Tutorials in Introductory Physics* [1] were originally developed by Lillian McDermott and the Physics Education Group at the University of Washington (USA) on the basis of more than ten years of research on student understanding in introductory physics. The *Tutorials* have been translated from English into other languages, including Spanish, Greek and German. Moreover, they served as a model for the development of instructional materials for other STEM subjects, such as electric circuits, engineering mechanics, fluid dynamics and engineering thermodynamics, as well as specific topics in mathematics.

In addition to providing hands-on experience with the instructional materials, we will discuss various aspects of incorporating the Tutorials into an introductory physics course and present data from a large study to assess their effectiveness. Moreover, we will report on recent developments in translating and extending the *Tutorials* to other academic fields. Participants are invited to reflect on the feasibility and merit of *Tutorials* in an age of widespread student use of AI.

Further topics to be discussed in the workshop are:

- the need to address conceptual difficulties,
- the research base underlying the development of the *Tutorials,*
- the assessment of the effectiveness of instructional materials,
- some practical aspects of implementing *Tutorials* in various course formats,
- productive ways to combine *Tutorials* with other interactive teaching methods.

[1] L. C. McDermott, P. S. Shaffer (2012). Tutorials in Introductory Physics. Pearson, ISBN: 978-1256371908