

Research Validated Distance Learning Labs for Introductory Physics Using IOLab

David Sokoloff, University of Oregon and Portland State University (PSU), USA

Erik Bodegom, Portland State University (PSU), USA

Erik Jensen, Chemeketa Community College, USA

The IOLab is a versatile, relatively inexpensive data acquisition device developed by Mats Selen and his colleagues at University of Illinois [1]. It is self-contained in a cart that can roll on its own wheels, while an optical encoder measures motion quantities. It also contains sensors to measure a variety of other physical quantities like force, temperature, light intensity, sound intensity and current and voltage. With a current cost of around \$100, students can purchase their own individual device (like a clicker), and can—in theory—use it to do hands-on laboratory, pre-lecture (flipped classroom) and homework activities at home. We report on the preliminary results of a project to develop distance-learning (DL) laboratories using the IOLab. We have developed *RealTime Physics* [3,4]-like mechanics labs based on the IOLab, tested them in supervised laboratory environments at PSU and Chemeketa, and just finished the first DL test of the labs at Chemeketa (Summer, 2016). We will present preliminary research on student learning and epistemological issues using the FMCE [5] and ECLASS [6].

[1] See <http://www.iolab.science/>

[2] Funded under U.S. National Science Foundation grant DUE – 1505086, July 1, 2015-June 30, 2017.

[3] David R. Sokoloff, Ronald K. Thornton and Priscilla W. Laws, "RealTime Physics: Active Learning Labs Transforming the Introductory Laboratory," *Eur. J. of Phys.:* **28** (2007), S83-S94.

[4] David R. Sokoloff, Ronald K. Thornton and Priscilla W. Laws, *RealTime Physics: Active Learning Laboratories, Module 1: Mechanics, 3rd Edition* (Hoboken, NJ, John Wiley and Sons, 2011).

[5] Ronald K. Thornton and David R. Sokoloff, "Assessing student learning of Newton's laws: The Force and Motion Conceptual Evaluation and the Evaluation of Active Learning Laboratory and Lecture Curricula", *Am. J. Phys.:* **66**, 338-352 (1998)

[6] See <http://www.colorado.edu/sei/departments/phys-advlab-eclass.htm>