Computational and Modeling Tools for Introductory Physics (CMTIP) Workshop

March 29 – 31, 2012 – Mt. San Antonio College, Walnut, CA

Martin Mason (Mt. San Antonio College, Walnut, CA)
Dwain Desbien (Estrella Mountain Community College, Avondale, AZ)
Tom O'Kuma (Lee College, Baytown, TX)

Recent physics education research indicates that the "traditional" lecture-style, passive learning model does not substantially impact the learning and understanding of most students who take introductory physics. The research also indicates that most students enter introductory physics with alternative conceptions to many of the basic concepts that are taught in introductory physics. For most students, passive learning techniques generally do not replace these "misconceptions" with concepts that are more consistent with our understanding of nature. Results from physics education research have identified several different active learning techniques that have substantially increased student conceptual understanding in introductory physics.

The modeling technique presented at the CMTIP workshop will be Modeling Discourse Management. Participants will experience a classroom management technique called modeling discourse management. While this classroom management style was created for a modeling curriculum, it can also be used with most PER based activities or curriculum. Modeling discourse management is an attempt to improve student-student interactions, student-teacher interactions, and classroom discussions.

The modeling theory of physics focuses the introductory physics curriculum around a small set of models. Participants will learn these models and practice applying them to physical situations. Essential to creating a useful model is to have quality-modeling tools. This workshop will introduce new modeling tools and demonstrate how to use existing tools in more robust ways.

Traditional Physics courses have a strong emphasis on analytical problem solving, however computational and numerical problem-solving techniques are as important for the modern engineering or science student. The 2002 AIP survey [i.Ivie & Stowe-2002] assessed graduates' work responsibilities and preparation for these provided by their physics education. The most significant discrepancies between their preparation and workplace requirements were in two areas: use of scientific software and ability to program computations. Computational modeling has emerged as an accepted, and in many STEM fields an indispensable, methodology for scientific research and engineering development. [ii. Duderstadt *et al.*-2002] For example, many science and engineering areas of research involve multi-physics modeling, where the interdependence of component processes lying in different physical domains can only be expressed in terms of couplings between separate computational models from each domain.

This workshop will show participants how they can introduce computation into their introductory courses. Participants will engage in a hands-on introduction to computational modeling in the Vpython programming language and learn to develop their own exercises and student projects. A framework for computational projects will be demonstrated along with several example projects and a set of sample computational exercises suitable for a laboratory environment.

There will also be an opportunity to share and discuss issues relating to implementation and to teaching physics more effectively. There will be extensive discussions on how to use various strategies, tools, and tactics to overcome problems and barriers. Discussion and information on the needs of the technological workforce and its connection with the activities of this workshop will also be presented. The workshop leaders have years of experience in developing and refining curriculum for introductory physics students. The workshop leaders have many years of experience in developing and refining curriculum for introductory physics students. In addition, and more importantly, the workshop leaders have had extensive experience with the implementation and adaptation of curriculum in a variety of institutions and for many types of introductory physics students along with the training of faculty in using and developing their own curricula for their technology-oriented students. This workshop is designed for TYC and HS teachers who are interested in using technology in lab and their courses to improve teaching and learning in introductory physics courses.

The local host will be Martin Mason who has provided strong leadership for an outstanding physics program in a suburban campus in a major city. Recently, the physics program at Mt. San Antonio College was selected as one of the ten outstanding TYC physics programs visited during the SPIN-UP/TYC project.

---

i . R. Ivie and K. Stowe, *The Early Careers of Physics Bachelors American Institute of Physics*, College Park, MD, AIP Pub. R-433.2, (2002).

ii . J. Duderstadt *et al. Issues for Science and Engineering Researchers in the Digital Age*. Ad Hoc Committee On Being A Scholar In The Digital Age, Office of Special Projects, National Research Council, Washington D.C. (2001)