CREATING A STUDENT-CENTERED COLLABORATIVE LEARNING ENVIRONMENT IN A UNIVERSITY PHYSICS CLASSROOM

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The time-honored conventional lecture ("teaching by telling") has been shown to be an ineffective mode of instruction for introductory physics classes. For enhancing critical thinking skills and developing problem-solving abilities, collaborative group-learning environments have proven far more effective. At George Washington University, we initiated a collaborative group-learning pedagogical approach (SCALE-UP) for classes in 2008. Since 2013, our introductory physics sequence has been taught exclusively in this mode, eliminating the "standard" lecture format, and this approach has been demonstrated empirically to yield higher gains in student learning.

In SCALE-UP, students sit at tables in groups of three, collaboratively performing various pencil/paper exercises (ponderables) using small whiteboards and engaging in hands-on activities like demos and labs (tangibles). Direct instruction (*i.e.* formal lecture presentation) is reduced to a minimal level, and the instructor serves more as a "coach" to facilitate the academic "drills" that the students are working on. This innovative pedagogy often arouses the curiosity of physics faculty, who wonder how the small-group format is organized and what activities constitute a typical class session. This workshop will answer these questions and will provide examples that can be implemented in your own classrooms.

This workshop is intended to be an active-engagement experience for all participants. We introduce student-centered learning environments and discuss challenges that might arise. Participants will then work together on several exercises illustrating the possible range of group-learning activities suitable for calculus-based introductory courses. Participants will learn how to develop and implement various hands-on and "minds-on" activities for their students in a collaborative pedagogical approach.

Workshop activities will include:

- Conceptual "clicker" questions.
- Whiteboard exercises consisting of conceptual or numerical problems.
- Group quizzes using "lottery ticket" scratch-off cards.
- Short hands-on exercises involving tangible manipulation.

The focus of the workshop will be on the in-class delivery of the exercises and the pedagogical value of the collaborative activities. The primary aim is for participants to experience this from the student perspective, which is necessary to fully appreciate the benefits of interactive engagement. The workshop is intended to demonstrate the feasibility and advantages of the collaborative group-learning approach and to inspire the workshop participants to implement such pedagogical reforms at their local institutions.