Physics Education Research and Its Role in Instructional Reform

Research on the learning and teaching of STEM subjects now occurs in most disciplines at the college level. This research has led to a heightened awareness of pedagogy and student learning, advances in instructional strategies, and highly effective, student-centered instructional materials. In physics, students’ understanding of many of the canonical introductory topics as well as various approaches to problem solving have been investigated, and models of student learning have been developed in these contexts. More recent work is exploring the upper division as well as interdisciplinary topics. Results from research have guided the development of both specific curricular materials and general instructional strategies, as well as assessment instruments to gather information about student understanding before, during, and after relevant instruction, thus enabling the assessment of student learning. These include individual free-response questions and multi-question multiple-choice surveys. In physics such instruments exist for introductory material as well as for advanced topics such as quantum mechanics and thermal and statistical physics.

I will present examples of PER projects and their results, including investigations of student understanding, development of instructional strategies and materials, assessment techniques and instruments used in research and to gauge the effectiveness of instruction, and dissemination and implementation of materials to educators.