In the small-class environment, we have implemented active learning techniques in an NSF-supported elementary physics course targeted at elementary education majors.[8] For (some) large classes, we use the "Flash Card" response system to obtain instantaneous feedback on multiple-choice *Workbook* questions from all students simultaneously.[9] Students also spend a large fraction of class time working in groups on carefully structured free-response sequences in the *Workbook*. Recitations in selected courses are replaced by University-of-Washington-style "tutorials": students work in groups on *Workbook* materials while T.A.'s provide guidance through Socratic questioning.

We also carry out basic research to support curriculum development. Graduate student Jack Dostal has been investigating student understanding of gravitation, by developing and administering free-response diagnostics and conducting in-depth videotaped student interviews. He is developing and assessing curricular materials to address learning difficulties identified in his research. In other research, we are investigating the comparative effectiveness of different representational modes, i.e., the relationship between the ***form of representation*** of physics concepts, and efficiency of student learning. We are also exploring factors underlying individual differences in student learning: why do some students start (conceptually) at the same point, yet finish at different points? How can instruction most effectively target these diverse groups of students?

We view PER as a systematic, multi-faceted endeavor to expand the horizons of physics education for the new millenium. By building on past achievements and relentlessly exploring new instructional possibilities, we hope to significantly increase the impact that physics instructors worldwide will be able to have on their students' educational development.

More information about our work can be found on our website http://www.public.iastate.edu/~per or by contacting us directly.

1. Lillian C. McDermott, *Millikan Lecture 1990: What we teach and what it learned – Closing the gap*, Am. J. Phys. **59**, 301 (1991).

2. Lillian C. McDermott, *Bridging the gap between teaching and learning: The role of research*, in ***Proceedings of the International Conference on Undergraduate Physics Education***, edited by E. F. Redish and J. S. Rigden, AIP, Woodbury, NY, Part One, pp. 139-165 (1997).

3. Frederick Reif, *Millikan Lecture 1994: Understanding and teaching important scientific thought processes*, Am. J. Phys. **63**, 17 (1995).

4. Arnold Arons, *Teaching Introductory Physics*, New York, Wiley, 1997.

5. Richard R. Hake, *Interactive engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses*, Am. J. Phys. **66,** 64 (1998).

6. Alan Van Heuvelen, *Overview, Case Study Physics*, Am. J. Phys. **59**, 898 (1991).

7. Eric Mazur, ***Peer Instruction, A User's Manual***, Upper Saddle River N.J., Prentice Hall (1997).

8. David E. Meltzer, *Effectiveness of instruction on force and motion in an elementary physics course based on guided inquiry*, AAPT Announcer **28(2),** 125 (1998).

9. David E. Meltzer and Kandiah Manivannan, *Promoting interactivity in physics lecture classes*, The Physics Teacher **34**, 72 (1996).

David E. Meltzer is Assistant Professor of Physics at Iowa State University, and is director of the ISU Physics Education Research Group.