

# Table of Contents

## I. Overview of the Group's Work

1. David E. Meltzer, "Iowa State University is new entrant into physics education research community" [invited paper], *American Physical Society Forum on Education Newsletter*, Summer 1999, pp. 12-13..... 3
2. David E. Meltzer, "Physics education at ISU" [invited paper], *Iowa State University Department of Physics and Astronomy [Alumni Newsletter]*, Fall 2001, pp. 13-14..... 5

## II. Teacher Preparation and Instruction for Pre-College Students

3. David E. Meltzer and Amy Woodland Espinoza, "Guided inquiry: Let students 'discover' the laws of physics for themselves," *Science Scope* **21** (2), 28-31 (October 1997) ..... 9
4. David E. Meltzer, "'Micro-Document' for National Science Foundation teacher education workshop," invited paper prepared for the National Science Foundation workshop *Teacher Education: From Preparation to Practice*, Washington, D.C., May 7-8, 1999..... 13

## III. Active Learning in Large Classes

5. David E. Meltzer and Kandiah Manivannan, "Promoting interactivity in physics lecture classes," *The Physics Teacher* **34** (2), 72-76 (February 1996)..... 17
6. Kandiah Manivannan and David E. Meltzer, "Increasing active student participation in the classroom through the use of 'flash cards'," in *The Changing Role of Physics Departments in Modern Universities: Proceedings of the International Conference on Undergraduate Physics Education*, edited by Edward F. Redish and John S. Rigden [American Institute of Physics Conference Proceedings **399** (Part One), 821-822 (1997)]..... 23
7. David E. Meltzer, "Nontraditional approach to algebra-based general physics," in *The Changing Role of Physics Departments in Modern Universities: Proceedings of the International Conference on Undergraduate Physics Education*, edited by Edward F. Redish and John S. Rigden [American Institute of Physics Conference Proceedings **399** (Part One), 823-825 (1997)]..... 25
8. Kandiah Manivannan and David E. Meltzer, "Use of in-class physics demonstrations in highly interactive format," in *Proceedings of the Physics Education Research Conference, Rochester, New York, July 25-26, 2001*, edited by Scott Franklin, Jeffrey Marx, and Karen Cummings (PERC Publishing, Rochester, New York, 2001), pp. 95-98 ..... 29
9. David E. Meltzer and Kandiah Manivannan, "Transforming the lecture-hall environment: The fully interactive physics lecture," *American Journal of Physics* **70** (6), 639-654 (June 2002)..... 33
10. David E. Meltzer, "Using active-engagement teaching methods in large-enrollment classes to improve student learning" [invited paper], *Teaching at ISU* [newsletter of the Iowa State University Center for Teaching Excellence] **15** (2), 1-2 (November/December 2002)..... 49

11. David E. Meltzer, “Enhancing active learning in large-enrollment physics courses” [invited chapter], in *Best Practices and Lessons Learned: Highlights from the NSF Collaboratives for Excellence in Teacher Preparation Program and Other Innovative Programs Around the Country*, edited by Diane Smith and Elisabeth Swanson (Montana State University, Bozeman, MT, in press)..... 51

#### IV. Student Learning and Reasoning in Thermodynamics

12. David E. Meltzer, “Student reasoning regarding work, heat, and the first law of thermodynamics in an introductory physics course,” in *Proceedings of the Physics Education Research Conference, Rochester, New York, July 25-26, 2001*, edited by Scott Franklin, Jeffrey Marx, and Karen Cummings (PERC Publishing, Rochester, New York, 2001), pp. 107-110 ..... 61
13. David E. Meltzer, “Investigation of students’ reasoning regarding heat, work, and the first law of thermodynamics in an introductory calculus-based general physics course,” *American Journal of Physics* **72 (11)**, 1432-1446 (November 2004) ..... 65
14. David E. Meltzer, “Investigation of student reasoning regarding concepts in thermal physics,” *American Physical Society Forum on Education Newsletter*, Spring 2005, pp. 4-5 ..... 81
15. David E. Meltzer, “Student learning in upper-level thermal physics: Comparisons and contrasts with students in introductory courses” [invited paper], in *2004 Physics Education Research Conference [Sacramento, California, 4-5 August 2004]*, edited by Jeffrey Marx, Paula R. L. Heron, and Scott Franklin [American Institute of Physics Conference Proceedings **790**, 31-34 (2005)] ..... 83
16. Thomas J. Greenbowe and David E. Meltzer, “Student learning of thermochemical concepts in the context of solution calorimetry,” *International Journal of Science Education* **25 (7)**, 779-800 (July 2003) ..... 87

#### V. Multiple Representations and Learning of Physics

17. Laura McCullough and David E. Meltzer, “Differences in male/female response patterns on alternative-format versions of FCI items,” in *Proceedings of the Physics Education Research Conference, Rochester, New York, July 25-26, 2001*, edited by Scott Franklin, Jeffrey Marx, and Karen Cummings (PERC Publishing, Rochester, New York, 2001), pp. 103-106..... 111
18. Ngoc-Loan Nguyen and David E. Meltzer, “Initial understanding of vector concepts among students in introductory physics courses,” *American Journal of Physics* **71 (6)**, 630-638 (June 2003)..... 115
19. David E. Meltzer, “Student learning of physics concepts: Efficacy of verbal and written forms of expression in comparison to other representational modes” [invited paper], in *Conference on Ontological, Epistemological, Linguistic and Pedagogical Considerations of Language and Science Literacy: Empowering Research and Informing Instruction*, University of Victoria, Victoria, British Columbia, Canada, September 13, 2002; <http://www.educ.uvic.ca/faculty/lyore/sciencelanguage/> ..... 125
20. Ngoc-Loan Nguyen and David E. Meltzer, “Visualization tool for 3-D relationships and the right-hand rule,” *The Physics Teacher* **43 (3)**, 155-157 (March 2005)..... 143

21. David E. Meltzer, "Relation between students' problem-solving performance and representational format," *American Journal of Physics* **73** (5), 463-478 (May 2005)..... 147

**VI. Methodological Issues in PER**

22. David E. Meltzer, "The relationship between mathematics preparation and conceptual learning gains in physics: a possible 'hidden variable' in diagnostic pretest scores," *American Journal of Physics* **70** (12), 1259-1268 (December 2002)..... 165

23. David E. Meltzer, "Issues related to data analysis and quantitative methods in PER" [invited paper], in *Proceedings of the 2002 Physics Education Research Conference [Boise, Idaho, 7-8 August 2002]*, edited by Scott Franklin, Karen Cummings, and Jeffrey Marx (PERC Publishing, New York, 2002), pp. 21-24 ..... 175

24. David E. Meltzer, "The questions we ask and why: Methodological orientation in physics education research" [invited paper], in *2003 Physics Education Research Conference [Madison, Wisconsin, 6-7 August 2003]*, edited by Jeffrey Marx, Scott Franklin, and Karen Cummings [American Institute of Physics Conference Proceedings **720**, 11-14 (2004)] ..... 179

25. David E. Meltzer, "How do you hit a moving target? Addressing the dynamics of students' thinking" [invited paper], in *2004 Physics Education Research Conference [Sacramento, California, 4-5 August 2004]*, edited by Jeffrey Marx, Paula R. L. Heron, and Scott Franklin [American Institute of Physics Conference Proceedings **790**, 7-10 (2005)] ..... 183

**VII. PER in Overview**

26. David E. Meltzer, "Mini-course on physics education research and research-based innovations in physics instruction" [invited paper], in *Memorias del XII Taller Internacional: Nuevas Tendencias en la Enseñanza de la Física* [Proceedings of the XII International Workshop: New Trends in Physics Teaching], *Puebla, Mexico, May 27-30, 2004*, edited by Josip Slisko, Cupatitzio Ramírez, and Adrián Corona (Benemérita Universidad Autónoma de Puebla, Facultad de Ciencias Físico Matemáticas, Cuerpo Académico de Investigación Educativa, Puebla, Mexico, 2004), pp. 28-35..... 189

27. Paula R. L. Heron and David E. Meltzer, "The future of physics education research: Intellectual challenges and practical concerns" [Guest Editorial], *American Journal of Physics* **73** (5), 390-394 (May 2005)..... 199

28. Paula R. L. Heron and David E. Meltzer, "Chemical education and physics education: Facing joint challenges and practical concerns," *CHED Newsletter* [published by the Division of Chemical Education, American Chemical Society], Fall 2005, pp. 35-37 ..... 205

29. David E. Meltzer, Lillian C. McDermott, Paula R. L. Heron, Edward F. Redish, and Robert J. Beichner, "A call to the AAPT Executive Board and Publications Committee to expand publication of physics education research articles within the American Journal of Physics," report to the American Association of Physics Teachers, revised December 29, 2003 ..... 209

30. Bibliography of PER papers published in the *American Journal of Physics*, January 1972-August 2005 [compiled by David E. Meltzer] ..... 223