# ABSTRACT

Title of Dissertation: BEYOND PROBLEM SOLVING:
EVALUATING INTRODUCTORY PHYSICS
COURSES THROUGH THE HIDDEN CURRICULUM

Jeffery M. Saul, Doctor of Philosophy, 1998

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A large number of innovative approaches have been developed based on Physics Education Research (PER) to address student difficulties introductory physics instruction. Yet, there are currently few widely accepted assessment methods for determining the effectiveness of these methods. This dissertation compares the effectiveness of traditional calculus-based instruction with University of Washington's *Tutorials,* University of Minnesota's *Group Problem Solving & Problem Solving Labs,* and Dickinson College's *Workshop Physics.* Implementation of these curricula were studied at ten undergraduate institutions. The research methods used include the Force Concept Inventory (FCI), the Maryland Physics Expectation (MPEX) survey, specially designed exam problems, and interviews with student volunteers. The MPEX survey is a new diagnostic instrument developed specifically for this study.

Instructors often have learning goals for their students that go beyond having them demonstrate mastery of physics through typical end-of-chapter problems on exams and homeworks. Because these goals are often not stated explicitly nor adequately

reinforced through grading and testing, we refer to this kind of learning goal as part of the course's "hidden curriculum." In this study, we evaluate two aspects of student learning from this hidden curriculum in the introductory physics sequence: conceptual understanding and expectations (cognitive beliefs that affect how students think about and learn physics).

We find two main results. First, the exam problems and the pre/post FCI results on students conceptual understanding showed that the three research-based curricula were more effective than traditional instruction for helping students learn velocity graphs, Newtonian concepts of force and motion, harmonic oscillator motion, and interference. Second, although the distribution of students' expectations vary for different student populations, the overall distributions differ considerably from what expert physics instructors would like them to have and differ even more by the end of the first year. Only students from two of the research-based sequences showed any improvement in their expectations.

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# THROUGH THE HIDDEN CURRICULUM

by

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Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
1998

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# Dedication

This work is dedicated to my family, friends, and colleagues who always gave me support and encouragement, to my students who made me think about how to teach them more effectively, to Joy Watnik, my significant other, for her understanding, patience, assistance, and moral support and to my advisor, Edward Redish, without whose help this dissertation would never have been completed.

# Acknowledgements

I would like to thank the members of the University of Maryland Physics Education Research Group, Richard Steinberg, Lei Bao, Dan Campbell, John Layman, John Lello, Chris Allen and Mel Sabella, who contributed substantially to the collection and analysis of the data presented in this dissertation. I would also like to thank Maria Crosson, Sam Berner, and Carlee Boettger for their help processing the data. Visitors to the group, including John Christopher, Alvin Sapirstein, and Pratibha Jolly, contributed valuable comments and insights. I am grateful to Pat Cooney, Ibrahim Halloun, Richard Hake, Curt Heiggelke, Alan van Heuvelen, Ed Adelson, Chris Cooksey and Tom Foster as well Lillian C. McDermott and the members of the University of Washington Physics Education Research Group for the discussions we shared on assessment issues and for their encouragement of this research. I am particularly grateful to Priscilla Laws for her many years of encouragement and support for this project and to me personally.

A project like this can not be completed without the help and cooperation of many people at many institutions. I would like to thank the very many faculty members at Carroll College, Dickinson College, Drury College, Ohio State University, University of Maryland, University of Minnesota, Moorhead State University, Nebraska Wesleyan University, Prince Georges Community College, and Skidmore College who cooperated with us and gave us class time for their students to fill out the concept tests and our survey. I am especially grateful to Bill Welch at Carroll College, Maurinda Wingard and Phil Thompson at Dickinson College, Bruce Callen at Drury College, Ken Heller, Pat Heller, Tom Foster and Laura McCullough at the University of Minnesota, Gerald Hart at Moorhead State University, Bob Fairchild and Bill Wehrbein at Nebraska Weslyan

University, Chris Cooksey and Leith Dyer at the Ohio State University, Scott Sinex and Barbara Gage at Prince Georges Community College, and William Standish at Skidmore College for agreeing to participate in this study and coordinating the collection of data at their institutions.

I am also very grateful to Priscilla Laws and her colleagues at the Dickinson College Summer Workshops for agreeing to let us give our survey to workshop participants and to Larry Kirkpatrick and his colleagues for permitting us to survey the US Physics Olympics Team students.

I would also like to thank several people for their help while I was writing this dissertation. I would like to thank Richard Steinberg and Michael Wittmann for the many hours spent proofreading the manuscript. I would also like to thank Mel Sabella for his help with various aspects of the project including coming in on a Sunday to rescue my advisor and me when we were trapped in the basement. I am also grateful to my committee for the opportunity to write the first physics education dissertation at the University of Maryland.

Last but not least, I would like to thank my advisor, Edward Redish, who has been a good friend, mentor, and colleague. Thank you, Joe, for your time and effort, for helping me develop as an instructor and a researcher, and most of all for believing in me.

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