

ABSTRACT

Title of Dissertation: BEYOND PROBLEM SOLVING:
 EVALUATING INTRODUCTORY PHYSICS
 COURSES THROUGH THE HIDDEN CURRICULUM
 Jeffery M. Saul, Doctor of Philosophy, 1998

Dissertation directed by: Professor Edward F. Redish
 Department of Physics

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.

BEYOND PROBLEM SOLVING:
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by

Jeffery M. Saul

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Advisory Committee:

Professor Edward F. Redish, Chair/Advisor
Professor Thomas D. Cohen
Associate Professor Richard F. Ellis
Professor James T. Fey
Professor Jordan A. Goodman
Professor John L. Layman

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.

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