



Impact of the FIU PhysTEC reform on introductory physics laboratories

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Introduction

Loss of potential contributions to physics as underrepresented students persist at a rate disproportionate to their presence in the overall population.

There is a deficit in research literature for university level reform efforts at institutions with a majority population of underrepresented students.

Figure 1. Physics bachelors granted to U.S. citizens by ethnic group.[1]

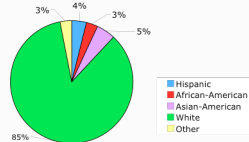
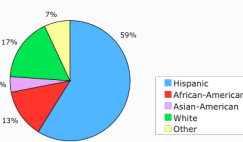


Figure 2. General FIU Population. [2]



Results and Analysis

Table 1. Data for the Force Concept Inventory.

Group	N	FCI		average normalized gain <g>*
		% pre class average <S>	% post class average <S>	
reformed lab	38	25	50	0.33
non-reformed lab	63	24	37	0.18

*<g> = (%<S>-%<S>)/ (100-%<S>) [4]

- FCI
- No significant difference on pretest scores for the two groups (t = 0.592, p = 0.555)
- Significant difference in posttest scores for students in reformed and non-reformed labs (t = 3.58, p < 0.001)
- Significant difference in normalized gains for students in reformed and non-reformed labs (t = 3.91, p < 0.001)

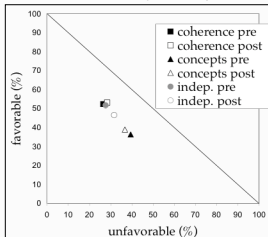


Figure 3. FIU Lab Reform MPEX 2 Data.

MPEX 2 Matched t-test analyses of pre and post favorability scores show no significant differences in any of the three main clusters or the five subclusters (see Figure 3).

Common Exam Questions Analysis of the scores on common exam questions indicates that students in reformed labs (n = 29) scored 14% higher than students not in reformed labs (n = 198) (p < 0.001).

FIU PhysTEC Lab Reform

Florida International University's (FIU) efforts at laboratory reform are an integral part of its work as a Physics Teacher Education Coalition (PhysTEC) Primary Partner Institution.

Following the University of Colorado at Boulder model, FIU is developing an integrated, multilevel pre-service program with a goal of improving and promoting the education of future physics teachers.

Reformed Lab Experience:

Modified tutorials and instructor-led demonstrations complement traditional lecture component [3].

Reformed Lab Sections:

- Graduate TAs and 1-2 undergraduate LAs act as facilitators of learning
- Students make predictions individually, come to a consensus as a group, perform investigations, and then reconcile those results with the consensus
- LAs checked for understanding at key points

Non-Reformed Labs:

- Graduate TA as instructor
- Traditional MBL labs
- Students complete labs in groups

Seminar in Physics Education:

- Science education class emphasizing findings in physics education research as related to field experiences including the reformed labs
- LAs reflected upon their attempts at implementing theory and traced their growth as both teachers and learners of physics
- Group work models quality learning experiences
- Students construct their understanding of physics teaching and learning
- Students challenge each other's constructions and schema



Undergraduate Learning Assistants (LAs):

LA Selection:

- Recruit top 20% of students in introductory physics
- Students with interest in physics teaching as a profession
- Potential LAs have opportunity to join large, supportive learning community

LA Training for Reformed Labs:

- TAs and LAs train together weekly with faculty and teacher-in-residence
- Work through tutorials clarifying physics concepts as well as discussing student conceptions and pedagogy
- Develop hypothetical dialogues using Socratic questioning techniques to address naive conceptions

Methods

Roughly two thirds of Physics I students enrolled in 14 lab sections. The labs included a random mix of students from both the calculus and algebra-based courses. Six of the fourteen introductory physics lab sections were chosen for the reform treatment.

Force Concept Inventory (FCI): conceptual understanding of Newtonian force and motion [5]

Maryland Physics Expectation Survey 2 (MPEX 2): attitudes and beliefs about physics and learning physics [6]

Free response conceptual common exam problems: problem-solving

Two-sample t-tests compare student learning gains on the FCI and performance on common exam questions.

A matched t-test compared differences in favorability scores on the MPEX 2 for students in reformed labs (only students with pre and post scores are included).

Discussion and Future Research

- Lab Reform Produced Learning Gains and Positive Epistemological Result
- Improved FCI normalized gain by factor of 1.8 over traditional labs
- Common exam questions performance 14% better than traditional labs
- No significant decrease in MPEX2 clusters (accepted as positive result [7])

FCI normalized gain of 33% is comparable to results for other reform efforts with underrepresented groups [8].

We intend to double the number of sections for the reform treatment to strengthen our results, explore the effects of our lab reform on problem solving ability, and allow for comparisons by group, especially gender and ethnicity.

FIU will use these results to further efforts to reform traditional lectures.

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