Introductory Physics Gender Gaps at the Colorado School of Mines: Pre- and Post-Studio Transition

Introduction

- Gender participation gaps exist at all levels in physics
- Gender performance gaps also exist[1]
- CSM physics is committed to understanding and shrinking both kinds of gap

Project Goals

- To identify and characterize gender gaps in CSM introductory E&M (Physics 200)
- To determine the impact of Studio physics on gender gaps
- To test hypothesis that more interactive courses result in smaller gender gaps[2,3]

Studio at CSM

- Hybrid Studio/lecture format (2 hrs lecture & 4 hrs Studio per week)[4]
- Based on existing models including Studio, SCALE-UP, TEAL
- Curriculum partially redeveloped to facilitate investigation, group work, and to include elements of cognitive apprenticeship[5,6]
- Physics 100 converted to Studio in late 1990s; Physics 200 followed in Fall 2007

- Studio groups that have any women have at least two[7]
- Usually at least one female TA per section
- Lectures are partially interactive, featuring Peer Instruction[8]

Gap in fraction of students receiving D, F, or withdrawing from course. No significant gender gaps

Gap in average course grade, students receiving C or better. Statistically significant, but small, gaps

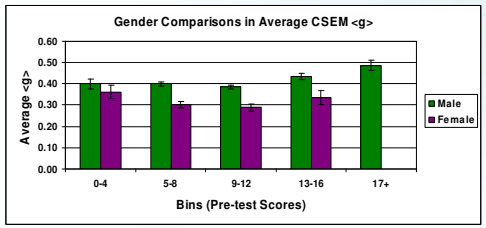
Gap in CSEM normalized gain. Large, significant gaps that close somewhat in Studio physics

Data show differences between male and female performances for Studio and non-Studio courses, and the statistical significance of the change from non-Studio to Studio when appropriate

	DFW Rate	Course Grade (C or better)	CSEM <g>	CSEM Pretest	CSEM Posttest
<M-F> non-Studio	-2.4% (p=0.4)	2.1% (<0.01)	12% (<0.0001)	7.1% (<0.0001)	13% (<0.0001)
<M-F> Studio	-0.4% (p > 0.8)	1.2% (0.03)	8% (<0.0001)	4.2% (<0.0001)	8.3% (<0.0001)
p non-Studio vs. Studio	----	p = 0.12	p = 0.01	p = 0.001	p = 0.001

Incoming (pretest) gap has closed recent years; posttest gap has narrowed further

Non-Studio includes all courses from Fall 05-Spring 07. Studio includes from Fall 07 to Spring 09. Total N of 2577



One potential explanation of CSEM gender gaps is that women may make up a disproportionate share of the low-pretest population, which may show lower gains. Binning students according to pre-test scores shows that gain gaps are present regardless of pre-test score. Few women scored in the highest bin, so we omit them

	ACT Scores		Grades	
	Composite	Math	Calculus 111	Calculus 112
Male	27.5 (out of 36)	29.1	2.95 (out of 4.0)	2.81
Female	27.7	28.4	3.07	2.83

ACT scores and prerequisite math class grades characterize the incoming population; we see no substantial differences. Scores are nearly constant over the four-year study period, so we present overall averages

Data

- Available data include DFW rates, course grades, grades on course components, ACT scores, grades in prerequisite courses, and results from research-based surveys. Most relevant data are shown (left)
- CSEM is the Conceptual Survey on Electricity and Magnetism[9]
- Especially stable curricula and faculty ease comparisons across semesters
- Statistical tests are two-tailed z-tests or binomial proportion tests, as appropriate.

Conclusions

- Course grades/DFW rates show small/non-existent gaps. Course grade is weighted heavily towards mathematical tasks, which women perform roughly equally on
- CSEM scores show significant gaps in conceptual understanding. Gaps are present at the beginning of the course and increase in size by the posttest
- Men and women show different conceptual development in Physics 200; Studio Physics has evened things somewhat
- Results are consistent with hypothesis that more interactive courses reduce gender gaps; however, few gaps existed to begin with

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