Do men outperform women in college physics?

If so, what can we do about it?
Examine FCI scores and grades by gender and high school background

Data from eight introductory courses ($N = 2777$)

Sample includes wide range of students, classroom settings, pedagogy
Do men outperform women in college physics?

YES (on average)
Possible sources:

Culture
High school physics
College course pedagogy
Instructor gender
Why is there a gender gap?

Possible sources:

Culture

High school physics

College course pedagogy

Instructor gender

Gap exists between men and women with same physics background
Possible sources:

Culture

High school physics

College course pedagogy

Instructor gender

Gap exists before class starts
Possible sources:

Culture

High school physics

College course pedagogy

Instructor gender

Reform effort offers opportunity!
Does pedagogy affect observed gap?

Classify courses as traditional, hybrid, or fully interactive

Courses use Tutorials, Peer Instruction, Studio Physics, Coop. Group Prob. Solving
Results

Traditional courses

![Bar chart showing average FCI pretest scores for Creighton and WPI, differentiated by gender (women in red, men in blue). The chart shows higher scores for men at both institutions.](chart.png)
Traditional courses

<table>
<thead>
<tr>
<th>FCI posttest</th>
<th>Creighton</th>
<th>WPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>80%</td>
<td>60%</td>
</tr>
<tr>
<td>80%</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>60%</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>40%</td>
<td>20%</td>
<td>0%</td>
</tr>
</tbody>
</table>

average score (%)
Hybrid courses

Results

FCI pretest

TTU | UMN | Purdue
---|-----|-----
80 | 60  | 40  
60 | 40  | 20  
40 | 20  | 0   
20 | 0   | 0   

Results

Hybrid courses

Average score (%)

FCI posttest

TTU

UMN

Purdue
Results

Fully interactive courses

- Charleston: FCI pretest score
- RPI: FCI pretest score
- Harvard: FCI pretest score
Fully interactive courses

FCI posttest

average score (%)

Charleston

RPI

Harvard
FCI summary:

- Women score lower on posttest
- Harvard (fully interactive) and TTU (hybrid) show greater gain for women
- Others show comparable gain (and lower $<g>$) for women
FCI summary:

- Women score lower on posttest
- Harvard (fully interactive) and TTU (hybrid) show greater gain for women
- Others show comparable gain (and lower $g$) for women
- Pedagogy may help, but no simple answers
Harvard calculus-based, 1990-1997

FCI pretest

average score (%)

traditional  hybrid  fully interactive
Harvard calculus-based, 1990-1997

Results

FCI posttest

average score (%)

traditional    hybrid    fully interactive
What about grades?
Results

Purdue grade distribution

Similar results from all schools
What differentiates courses within groups?
Female-friendly pedagogy:

Cooperative class environment

Opportunities to ask and explain

Hands-on experience with equipment
Female-friendly pedagogy:

Cooperative class environment
Opportunities to ask and explain
Hands-on experience with equipment

Participation matters!
What differentiates courses within groups?

Is assessment part (or all) of the problem?

What is the role of instructor gender?
Conclusions

Gender gap in FCI posttest and grades seen at all eight schools

Gap begins before college

Pedagogy may help, but needs further study

Reform effort has an opportunity!
Funding: National Science Foundation

Data: K. Kelvin Cheng, Karen Cummings, Linda Jones, Thomas Keil, Janet Seger

For a copy of this talk and additional information:
http://mazur-www.harvard.edu
Results

Traditional courses

<table>
<thead>
<tr>
<th>FCI gain</th>
<th>Creighton</th>
<th>WPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>average score (%)</td>
<td>100</td>
<td>80</td>
</tr>
</tbody>
</table>

FCI gain

average score (%)

Creighton

WPI
Harvard grade distribution

Results