Learning Assistants in Introductory Science Classes

Research Results and Methods

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For the 07 CLAW
Why Data Collection?

is essential for

• *systematic* improvements
• supporting faculty/institutional change
• ongoing financial support
• research activities
Data Collection:

What kinds?

• Logistics/statistics (how many courses, students, LAs, new teachers…)
• Conceptual development
• Attitudes and beliefs
• Traditional measures
• Longitudinal impacts
• Pedagogical Knowledge
• …
Force Concept Inventory

red = trad, blue = interactive engagement

\[ \langle g \rangle = \frac{\text{post-pre}}{100-\text{pre}} \]

R. Hake, "...A six-thousand-student survey..." AJP 66, 64-74 ('98).
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Student normalized gains

Average (2 semesters) = 0.44
Student normalized gains

Average (2 semesters) = 0.44
Average (4 semesters) = .54
Beliefs*  
(not “affect”)

Assessing the “hidden curriculum” - beliefs about physics and learning physics

Example:
• “To learn physics, I only need to memorize solutions to sample problems”

See http://class.colorado.edu
CLASS F06:
Comparing students & LAs

Phys 1120 F06

Phys 1110 F06

LAs, F06

Overall

Personal Interest

50

75

100
Longitudinal

Upper division majors’ BEMA scores

After completing upper div. E&M I or II.
(Only students who took intro without Tutorials)
**Longitudinal**

Upper division majors’ BEMA scores

![Bar chart showing BEMA scores for the years f04-f05 and s06-s07. The chart compares students with and without tutorials, with the blue bars representing students who had taken their freshman E&M with tutorials.]

**BLUE:** students who had taken their freshman E&M *with* Tutorials
Upper division majors’ BEMA scores

- f04-f05: (3.1 ± 0.1)
- s06-s07:
  - No Tutorials: (3.0 ± 0.1)
  - Tutorials: (3.3 ± 0.1)
  - Yellow: (3.2)

Yellow: students who had been E&M LAs
Types of data

- Research-based conceptual surveys
- Attitudes and beliefs about learning science and the nature of science (CLASS)
- Surveys/Affective responses
- FASCI
- Problem solving
- Numbers (students impacted, teachers produced, …)
- …
Bi-weekly DBER meetings

Discipline Based Education Research

- Math, Chemistry, MCDBiology, Astronomy, Geosciences, and Physics
- present research
- develop assessment tools
- collaborative data collection (CLASS, Lawson)
- reading group
What data are useful to you?

• Informing systematic improvements
• Supporting faculty change
• Assessing impacts (on students and LAs)
• Finding and fixing problems
• Retention/recruitment issues
• …
Questions?
Extra Slides - depending on questions!
Reconceptualize Recitation

Elicit, Confront, Resolve

Socratic Method
(=> 1.5 hr/wk prep/training)
Tutorial vs. Trad'Il Recitation
Weekly LA prep meetings

• 1-1.5 hours
• Opportunity for LA -> faculty feedback and faculty -> LA support!
  + examine student ideas
  + practice upcoming materials
  + explicit attention to pedagogy/questioning
• (Snacks are nice )
Other models!

- Learning Teams (e.g. Astronomy)
- Workshops/tutoring (e.g. Math, Phys)
- In-class activities
- ...

How would peers in your department respond to a possibility of you going into teaching?

LA: It would have been weird at first when I first started and people would be like oh ok. But now the LA Program is really affecting the way a lot of us think.... So now its kind of a normal thing to hear, ‘Oh yeah, I’m thinking about K-12.’ And... its not weird. Its not out of the ordinary where as a couple years ago it would have been strange for me to hear that.
Impact on Faculty

Faculty quotes

But I am spending a whole lot more time preparing lessons. I mean, I’ve taught [this course] a million times. I could do it in my sleep without preparing a lesson. But I’m spending a lot of time preparing lessons, trying to think ‘Okay, what is it I want them to go away knowing?’ Which I have to admit, I haven’t spent a lot of time in the past thinking about.

(STEM Colorado faculty member new to program)
Learning gains for LAs and TAs

Enrolled Students

Learning Assistants

Teaching Assistants (1st time)

LAs leave at incoming TA level!
<table>
<thead>
<tr>
<th>CLASS categories</th>
<th>Shift (%) (“reformed” class)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real world connect...</td>
<td>-6</td>
</tr>
<tr>
<td>Personal interest........</td>
<td>-8</td>
</tr>
<tr>
<td>Sense making/effort...</td>
<td>-12</td>
</tr>
<tr>
<td>Conceptual............................</td>
<td>-11</td>
</tr>
<tr>
<td>Math understanding...</td>
<td>-10</td>
</tr>
<tr>
<td>Problem Solving...........</td>
<td>-7</td>
</tr>
<tr>
<td>Confidence............................</td>
<td>-17</td>
</tr>
<tr>
<td>Nature of science............</td>
<td>+5</td>
</tr>
</tbody>
</table>

Engineers: -12

Phys Male: +1
Phys Female: -16

(All ±2%)
Effect and Reproducibility

1120 BEMA pre/post

F04 (N=319)  Pretest: 26%  S05 (N=232): 27%
g(F04) = 0.44 +/- 0.01  g(S05) = 0.43 +/- 0.01

CU upper division (trad)
Handoff to non-PER faculty

• Use same materials
• Same TA / LA training
• Same course structure /exams etc…

… everything looks the same…(except the instructor)
Non-PER Faculty
1st Time Teaching with Tutorials
Pre: 25
Post: 50  <g> = .33
1120 BEMA pre/post

Non-PER Faculty

2nd Time Teaching (+ PER backup)

Pre: 26

Post: 56

<g> = .40
Beyond the FMCE: Exam comparisons

N.B. 12 points is roughly 1 letter grade.
Impact on different pretest populations: "high starters" 50<pre<93%

 normalized gain for high pretest

<table>
<thead>
<tr>
<th>Semester</th>
<th>(% of class in this pool)</th>
<th>Tut course</th>
<th>Trad Recit</th>
</tr>
</thead>
<tbody>
<tr>
<td>S04 (13%)</td>
<td>(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F04 (22%)</td>
<td>(2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S05 (14%)</td>
<td>(3)</td>
<td></td>
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</tr>
</tbody>
</table>
Impact on different pretest populations: "low starters" pretest <=12.5%

**normalized gain for low pretest**

<table>
<thead>
<tr>
<th>Semester</th>
<th>(% of class in this pool)</th>
<th>Tut course</th>
<th>Trad Recit</th>
</tr>
</thead>
<tbody>
<tr>
<td>S04 (23%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F04 (20%)</td>
<td></td>
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<tr>
<td>S05 (22%)</td>
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</tbody>
</table>
Gender Gap in 1110 Pre and Post Scores

Gender Gap by semester

![Bar chart showing gender gap in pretest and post test scores across different groups.](chart.png)
Matched Analysis – Post Test

\[ r_{\text{pre}, \text{post}} = 0.562 \]