The Colorado Learning Assistant Programme
Transforming undergraduate education and K12 teacher recruitment and preparation

Using Student-Generated Content and Peer Support to Enhance Student Engagement and Learning
University of Manchester
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What will 30m. get us?

A bit of context on US education

The Learning Assistant Model

Outcomes / Measures / research

Q&A

How important is education?

In March 2001, the U.S. Commission on National Security/21st Century … on which I served warned that the crisis in scientific research and education is the second greatest threat facing American national security. In fact, the 14 bipartisan members unanimously agreed that the ‘inadequacies of our systems of research and education pose a greater threat to U.S. national security over the next quarter century than any potential conventional war that we might imagine.’ The Commission went on to assert that only a nuclear or biological weapon released in an American city [is] a greater threat

-Newt Gingrich, AEI
open letter to Congress, May 2005
Grand Challenges in US Education

Better education

U.S. ranks:
- 21 out of 30 in science
- 25 out of 30 in math
- PISA 2006

International Rankings (science)

Grand Challenges in US Education

Better education

More and better teachers

~ 2/3 Physics Out of Field
Less than 50% stay

Physics Teachers with degrees in:

- 22% Major Physics
- 10% Minor Physics

~ AP Medical Research Corp.
Grand Challenges in US Education
Better education
More and better teachers
More and better STEM grads

1 Million more STEM grads needed by 2018 and growing

Grand Challenges in US Education
Better education
More and better teachers
More and better STEM grads
Higher education & research

US surpassed by Europe and Asia in S&E PhD production
High Education & Disciplines: a key lever in education

Discipline-Based Education Research: Physics Education Research (PER)
Overview of PER

• Far more to our classes than what is traditionally evaluated
  – students are not learning what we want
  – learning some things we would not expect

• Physics education research
  – Tools for assessment
  – Models of student learning
  – curricula / approaches in class

A possible “tipping” point

• Force Concept Inventory*
• Multiple choice survey, (pre/post)
• Experts (especially skeptics!)
  necessary (not sufficient) indicator of conceptual understanding.

* Hestenes, Wells, Swackhamer, Physics Teacher 20, (92) 141
Sample question

Looking down at a track (flat on table), a ball enters at point 1 and exits at point 2. Which path does it follow as it exits (neglect all friction)?

We are not teaching students

Take home message:

*Students learn less than 25% of the most basic concepts (that they don’t already know).*

R. Hake, "...A six-thousand-student survey..." AJP 66, 64-74 ('98).
Attitudes & Beliefs:

Attitudes and Beliefs*

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

Examples:
• “I study physics to learn knowledge that will be useful in life.”
• “To learn physics, I only need to memorize solutions to sample problems”

### CLASS categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Shift (%)</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>

(All ±2%)

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actively engaging students is important
Many PER curricular innovations

Teach by actively engaging students…
based on what they know . . .
Engagement Improves Learning

traditional lecture  interactive engagement

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


modest reframing of class context
Tutorials in Introductory Physics

Reconceptualize Recitation Sections

- Materials
- Classroom format / interaction
- Instructional Role

Impact


Engagement in Learning

traditional lecture  interactive engagement

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

CU - IE &
trad recitations  CU - IE &
Tutorials


Program Goals

Teacher Recruitment & Preparation

Discipline-Based Education Research  Institutional change

Curriculum and course transformation
Content: Weekly planning sessions with math/science faculty member who is teaching the course (3 to 10) LAs per faculty member

Practice: LAs lead weekly Learning Teams of 6 to 20 students
Formative feedback for instructor to use in lecture

Pedagogy: LAs take a weekly course in science education theory and practice, civic responsibility for education

The Learning is embodied in the Experience

The LAs’ learning is moved outside of the classroom; into the experience of serving as an LA

Otero et al., Science 2006
In the LA Model: Learning is distributed throughout the system

Enrolled students learn the subject matter better

Learning Assistants learn subject matter and become better teachers & learners

University faculty become better teachers

Faculty and learning assistants recognize their role in educational change

Course transformed using Learning Assistants to facilitate collaboration
Learning by Teaching: the LA Story

CLASS F06: Comparing students & LA’s

Students in Phys 1120 F06

LA Program Impact on Teacher Recruitment

STEM Certification Program Graduates

ave # certificates per year

Before After
Participants (2003-2011)

**Astronomy**
- Dick McCray
- Doug Duncan
- Nick Schneider
- John Stocke
- Seth Hornstein
- Jack Burns
- Nils Halverson

**Chemistry**
- Tom Cech
- Robert Parson
- Amy Palmer
- Joe Falke
- Dan Feldheim

**Physics**
- Steve Pollock
- Kathy Perkins
- Carl Wieman
- Carl Rogers
- Murray Holland
- Thomas Schibli
- Noah Finkelstein
- Mike Dubson
- Ed Kinney
- Jim Shepard
- James Nagle

**Education**
- Valerie Otero
- Steve Iona
- David Webb
- Derek Briggs

**MCD Biology**
- Bill Wood
- Nancy Gould
- Jia Shi
- Michelle Smith
- Tom Blumenthal (chair)

**K-12 Teachers**
- Steve Iona
- Mike Fuchs
- Roberta Tanner
- Craig Schneider
- Karen Germann

**Graduate Students**
- Kara Gray
- Kim Gatl
- Heidi Iverson
- Chandra Turpen
- Mike Ross

**Mathematics**
- Eric Stade (Chair)
- Rob Tubbs
- Evelyn Puau

**Engineering**
- Derek Reamon
- Daria Kates-Schwartz
- Michael Hannigan

**Geology**
- Alexis Templeton

1058 LA positions filled!

Chancellor DiStefano, Provost Moore, Dean Shepard (Educ), Dean Gleeson (A&S)

Fin

Much more at: per.colorado.edu
And laprogram.colorado.edu
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