Building partnerships between tutorial reformers and teaching assistants

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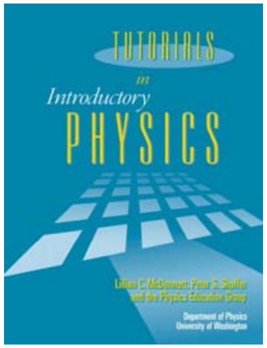
US university science ed reform

Most large introductory science courses still have a large lecture component, led by a professor.

- **Much reform takes place in recitation sections, where teaching assistants (TAs) are the instructors.**

At the Univ of Maryland:

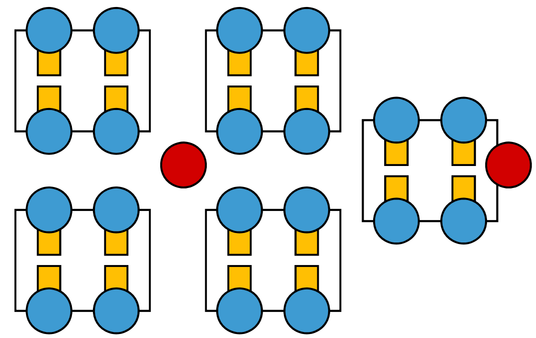
TAs facilitate small-group collaborative active-learning sessions centered on structured conceptual worksheets **("tutorials")**



TAs' classroom context

- TAs are first-year physics grad students, overwhelmingly white, male, early 20s

- Students are junior and senior health and life science majors, ethnically diverse, majority female



Reform depends on TAs

TAs do much of the actual delivery of introductory university physics classes. *Frequently responsible for all small-group environments and thus for many of the most effective instructional innovations developed for these courses.*

TAs include almost all of the next generation of university faculty, who educate future K-12 teachers.

Questions for today

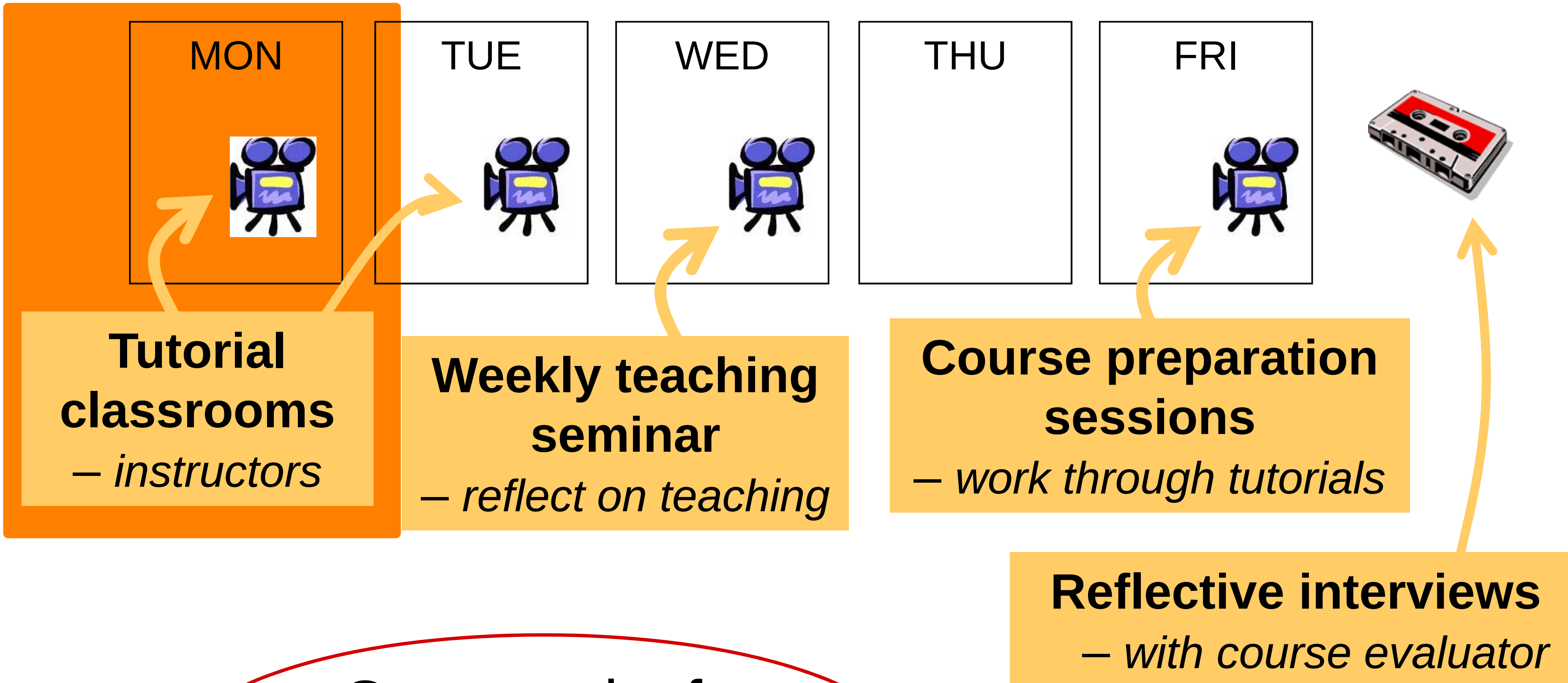
- What should TAs be doing?
- According to whom?
- How might TAs and reformers become partners in effective instruction?

Questions for today

- **What should TAs be doing?**

  What *are* TAs doing?

Data sources

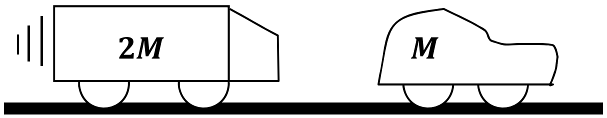


Opportunity for in-depth case studies

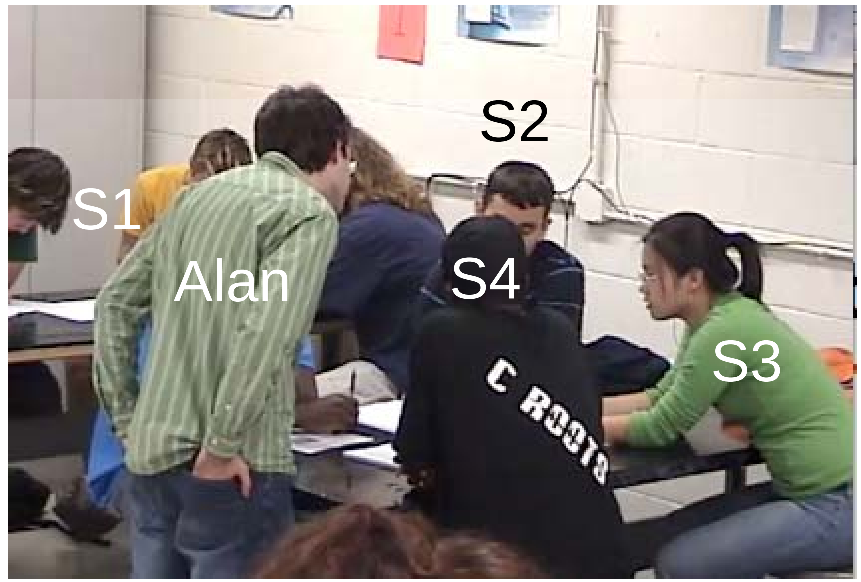
Alan: Episode 1

Tutorial:

Newton's Third Law



Goal: **Reconcile:**
(1) Two colliding objects each feel the same force
(2) A larger truck causes more damage to a smaller car when they collide.



A. If the truck slows down by 5 m/s during the collision, how much speed does the car gain?
B. Car and truck are in contact for 0.50 sec. Calculate the acceleration of each.

Alan: Episode 1 *(1.5 min)*

What's he doing? What do you think of it?

Confession of a tutorial reformer

When my colleagues and I
first watched this episode,
our attention was on
what we thought Alan was **doing wrong.**

We had no shortage of material.

Concerns about Alan - I

Alan constrains the conversation.
His conversational turns are the longest.
Students' gazes are mostly on him or their papers.

<u>Consequences:</u>
Students don't get to say what's going on for them.
Students don't hear each other's ideas.
Alan's choice of explanation is based on minimal information about its relevance.

Observation

Our interpretations of
specific tutorial interactions
reveal our pedagogical values.

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Consequences:

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Students don't hear each other's ideas.

Alan's choice of explanation is based on minimal information about its relevance.

TAs **should** value student ideas.

Concerns about Alan - II

Alan fails to elicit student ideas.

He does not ask:

- what the students have already tried
- whether there is some part they *do* understand
- whether the other students in the group could answer S3's question for her

TAs **should** help students build on their own ideas.

Concerns about Alan - III

Alan is satisfied with weak evidence of conceptual understanding.

He hasn’t really asked them to do anything.

He asks if they understand, and when they say yes, he leaves.

TAs **should** promote and assess conceptual understanding.

What TAs should do

?

Promote and assess conceptual understanding

Draw out students' ideas

Facilitate students building on their own ideas

Data sources

MON

TUE

WED

THU

FRI

Tutorial classrooms
– *instructors*

Weekly teaching seminar
– *reflect on teaching*

Course preparation sessions
– *work through tutorials*

Reflective interviews
– *with course evaluator*

Opportunity for in-depth case studies

Simple interview protocol

“How is [name of course] going?”

Epistemologically rich responses: participants state

- which aspects of the course they judge to be successful,
- which aspects are lacking,
- what features they believe should get more emphasis,

and otherwise reveal their values and expectations for instruction and their views about how students learn.

Alan's perspective - I

Quantitative results are the nature of physics.

"For me the point of physics is that there is this extremely powerful machinery that lets you get numbers and get precise and quantitative results."

They're also what students are graded on.

"I'm seeing a lot of frustration from my students, about the homework and what they're being graded on, and the fact that [tutorials are] not… And the tests, they'll have a lot of nonconceptual questions. [The students] are in a very unpleasant situation."

TAs **should** emphasize quantitative approaches.

Alan’s perspective - II

TAs and students are peers.

“I’m sort of the classmate who happens to get it, within reason. My role is sort of as a trav-, sort of a moving fifth group member who sort of falls asleep for periods of about five minutes and then wakes up and has taken the course before and failed it for personal reasons, you know, and, and who happens to know everything, you know, and so you can ask him when he’s awake.”

TAs **should** mostly act like fellow students, rather than being “teacherly.”

Alan’s perspective - III

Acknowledging understanding is a moral and pedagogical imperative.

“The tutorial assumes that they screwed up. It assumes that they were stupid. And every time I do the tutorial, there’s at least one group who doesn’t make the stupid mistake. And then they feel kind of offended. I saw this as a little personal: I remember being in high school, and my group did well, and then it’s very frustrating when the assumption behind everything the teacher is doing is that everybody will screw up. …It’s pedagogically dangerous.”

TAs **should** assume students probably understand.

Contrasting interpretations

Alan:

Constrains the conversation

Fails to elicit student ideas

Is satisfied with weak evidence of conceptual understanding

Gives students the help they request, with appropriate quantitative emphasis

Respects students' potentially sound understanding

Contrasting values

TAs should:

Promote and assess conceptual understanding

Value students' ideas

Facilitate students building on their own ideas

Emphasize quantitative approaches

Assume students already understand

Act like fellow students rather than teachers

What a mismatch.

Consequences of unaligned values

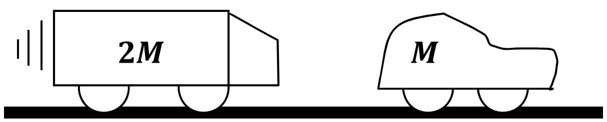
When TAs and reformers have different values,
everyone is frustrated.

TAs feel constrained by counterproductive-seeming rules like "Don't tell students the answers."

Reformers often don't know the details, but they see unhappy TAs and unhappy students.

Theoretical perspective

PER has long taken the perspective that effective physics curricula respect the physics ideas that novices bring to the classroom, seeing them as valuable material from which expert knowledge is constructed.



We think that effective P.D. will respect the teaching ideas that novice instructors bring to the classroom, seeing them as grounded in reasonable beliefs about physics and learning.

Alan: Episode 2

Tutorial:
Newton's Second Law

Goal: **Reconcile:**
(1) Zero net force results in constant velocity
(2) It seems like you'd need a net force to keep moving.

A child is pulled out of a well by a rope.
F(rope) > F(grav): child keeps speeding up.
F(rope) < F(grav): child slows down.
What happens to the child's motion if the rope force *equals* the child's weight, i.e., "compromises" between the above?

Alan: Episode 2 *(2 min)*

Try to take the other perspective.

Alan: Episode 2 *(2 min)*

Try to take the other perspective.

 *vs.* 

Questions for today

- What should TAs be doing?
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How to build partnerships

Premise:
The burden of partnership-building falls on those who design TA professional development.

Suggestions for designers:

1. **Recognize the commendable values that TAs already have.**

This takes research.

2. **Recognize the effect of the social and environmental context.**
3. **Give TAs the opportunity to encounter the phenomena of student thinking.**

2. Effect of environmental context

Unhappy TAs

Happy TAs

Same specific professional development activities.

2. Effect of environmental context

Unhappy TAs

Locally produced worksheets

Alg-based course

Epistemological component = “opinion”

Shorter, easier tutorials

Happy TAs

Calc-based course

Professionally produced worksheets

Pure physics content

Independent of PER group

Attendance required

On exams

Interdepartmental reform effort

2. Effect of environmental context

Unhappy TAs

Locally produced worksheets

Alg-based

tu

Happy TAs

Calc-based

Professionally produced worksheets

dependent of ER group

Attendance required

On exams

Interdepartmental reform effort

TAs hear many messages about what to value.

How to build partnerships

<u>Premise</u>:

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<u>Suggestions for designers</u>:

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3. Encounters with raw data

The FCI is not uniformly helpful.

"The Force Concept Inventory, how do I put this, this is designed to get you to pass the Force Concept Inventory. It does not test a whole range of things that would also be good to learn."

3. Encounters with raw data

A very different option:

The "Physics Interview Project"

- Interview a (non-physics) peer in order to **study that person's thought process** about some accessible physical system. (Not teach.) Self-videotaped.
- Transcribe part of the interview and perform it, explaining why it was interesting.
- Write a reflection paper characterizing the interviewee's thinking and summarizing the difficulty and value of the experience.

The "Physics Interview Project"

Puts participants face to face (literally) with the ***phenomena*** that are the subject of PER, not only the refined results.

- Compelling entry point into research
- Participants trusted to have direct contact with raw data and to reach independent conclusions

The “Physics Interview Project”

Preliminary results: *Participants learn that…*

- The urge to guide your interviewee to a particular conclusion is very strong.
- People do not necessarily say what they really think, even if they are not trying to deceive.
- The complexity of a real person’s thinking is much greater than research summaries indicate.
- People can make a lot of intellectual progress just by having the opportunity to reason things out.

Hope for aligning values

 *vs.* 

Activities in which
TAs and reformers reflect together
on rich (video) representations
of real people learning physics together
may help us understand each other better,

and then to collaborate.

Conclusions

- **What TAs "should be doing"** (or even *are* doing) **depends on who you ask.**
- **Contrasting values result in frustration for both TAs and reformers.**
- **"Meta-results" from PER can guide us in building partnerships for effective instructional reform.**