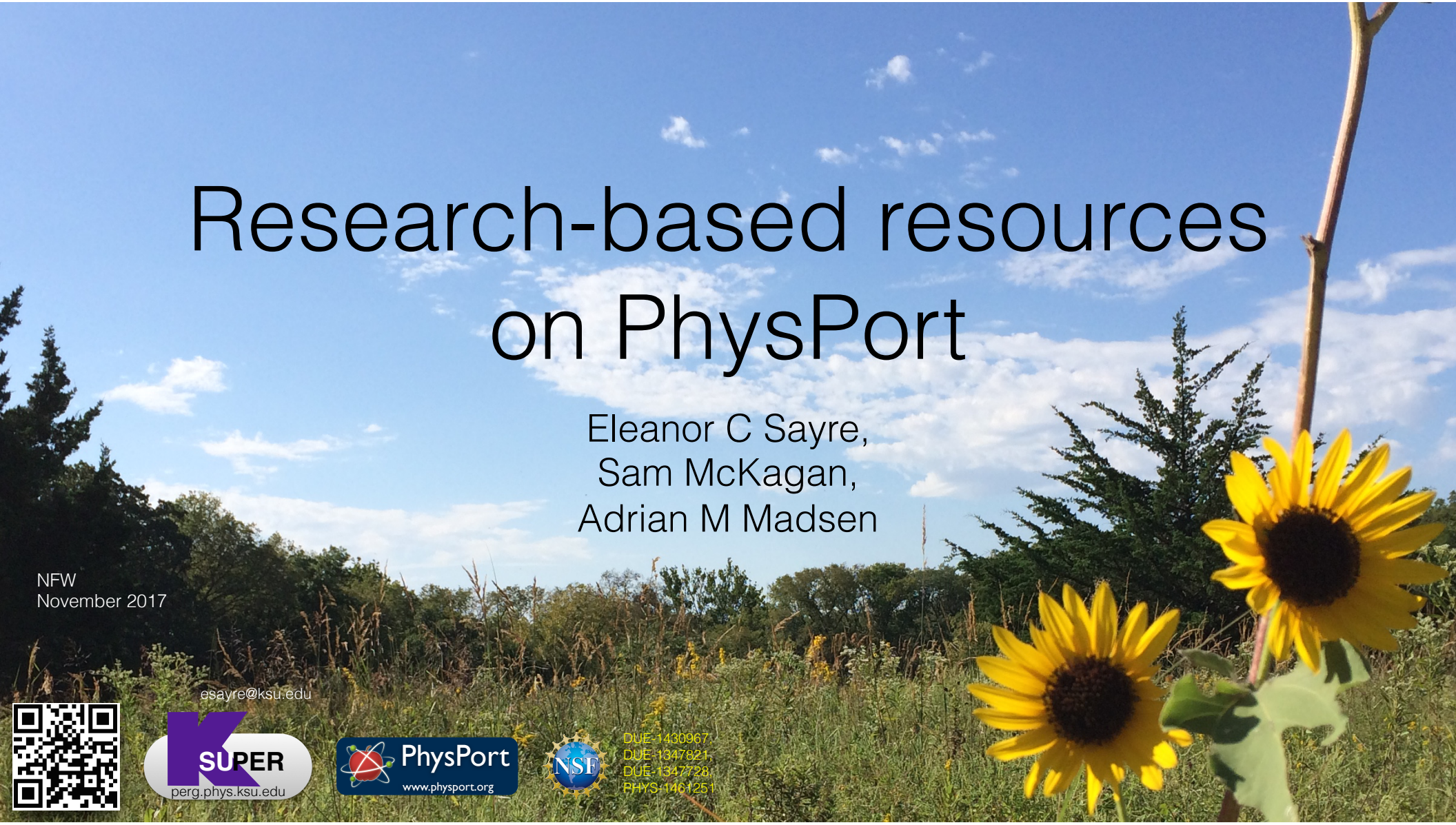


Research-based resources on PhysPort

Eleanor C Sayre,
Sam McKagan,
Adrian M Madsen

NFW
November 2017

esayre@ksu.edu

perg.phys.ksu.edu

www.physport.org

DUE-1430967,
DUE-1347821,
DUE-1347728,
PHYS-1461251

What is PhysPort?

A web resource to support physics professors in using research-based teaching and assessment in their classes

www.physport.org

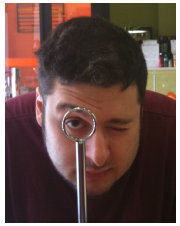
PhysPort Team

American Association of Physics Teachers




Sam McKagan (*Director*)
Adrian Madsen (*Assistant Director*)
Lyle Barbato (*development lead*)
Matt Riggsbee (*visual design*)

Kansas State University


Ellie Sayre (*Research Director*)
Eugene Vasserman (*security lead*)
Josh Weese (*development lead*)

Theresa Neil Design

Sandy Martinuk
(*User Experience*)

Periscope Specialists


Rachel Scherr
Stephanie Chasteen

Faculty have big questions.

How to compare teaching methods?

Which assessment should I use?

How do I prepare TAs?

How do I support diverse learners?

What works best for my context?

course

program

PhysPort can help.

NFW is overwhelming.

Finding information and advice

Changing teaching practices

Supporting physics teaching with research-based resources

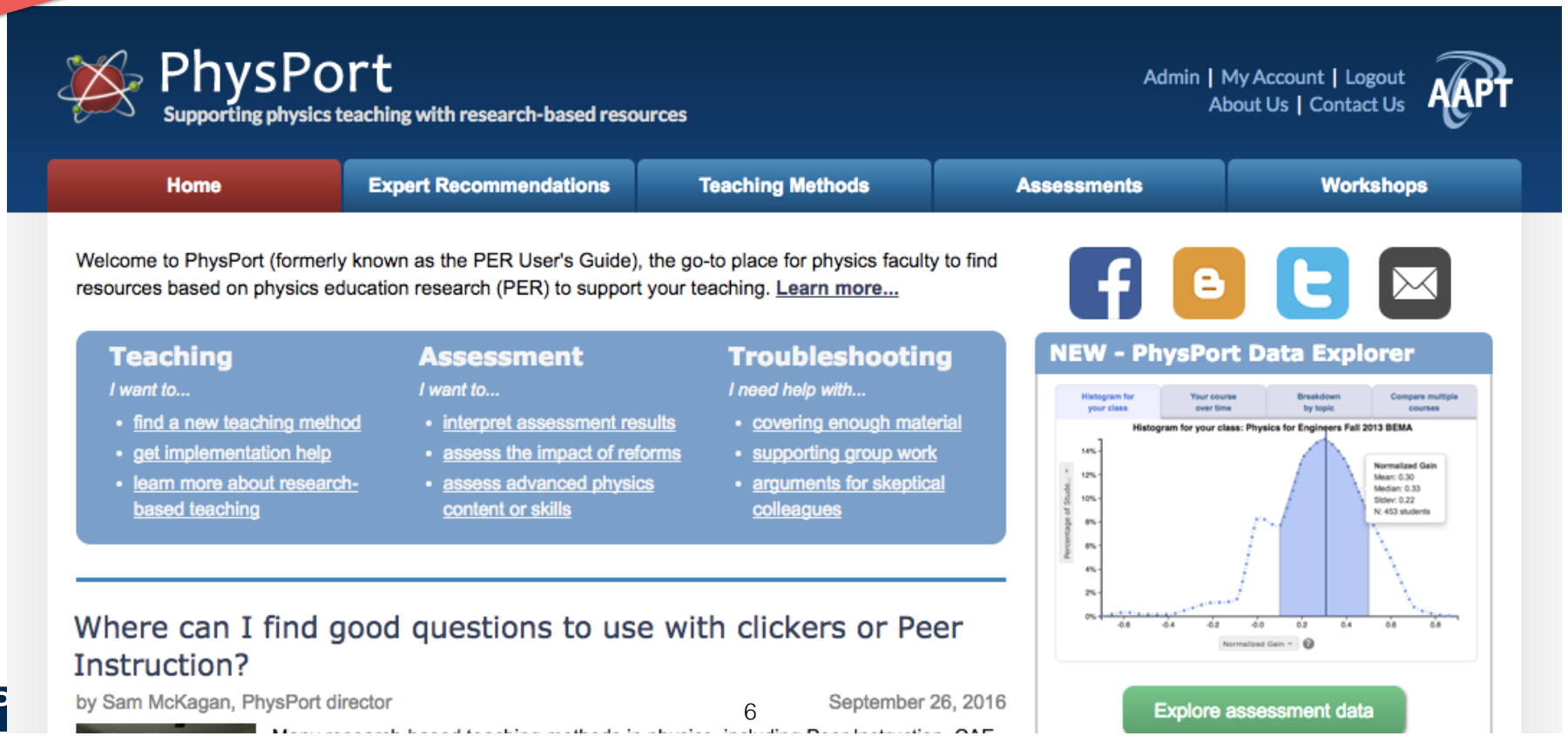
Faculty-centered online resources

Synthesis research

Eleanor Sayre, esayre@ksu.edu

go here now.

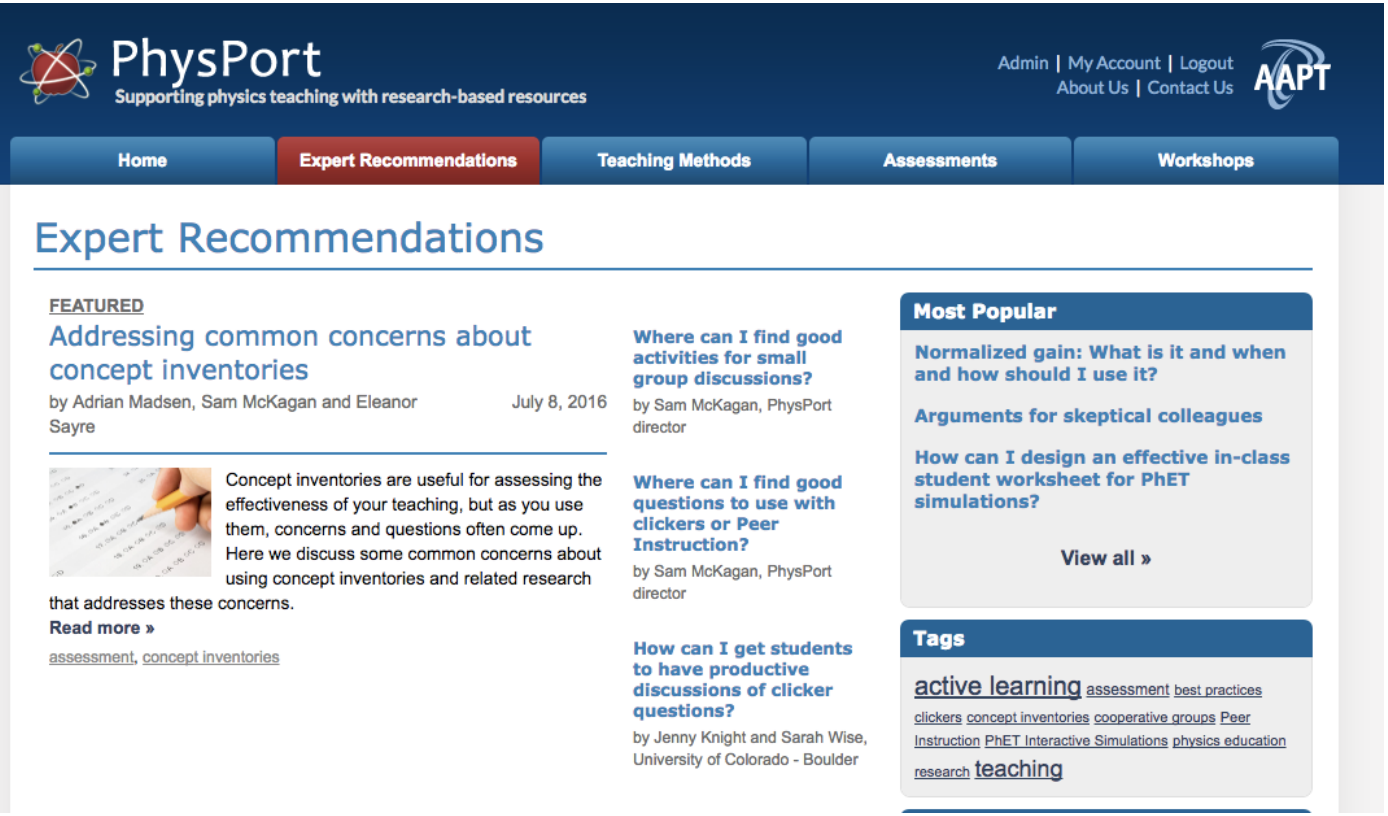
physport.org



Expert Recommendations

physport.org/recommendations

Friendly articles that interpret and synthesize PER results for physics faculty.



Real questions.

Research-based answers.

Faculty-centered resources.

Have a suggestion?

Want to contribute?

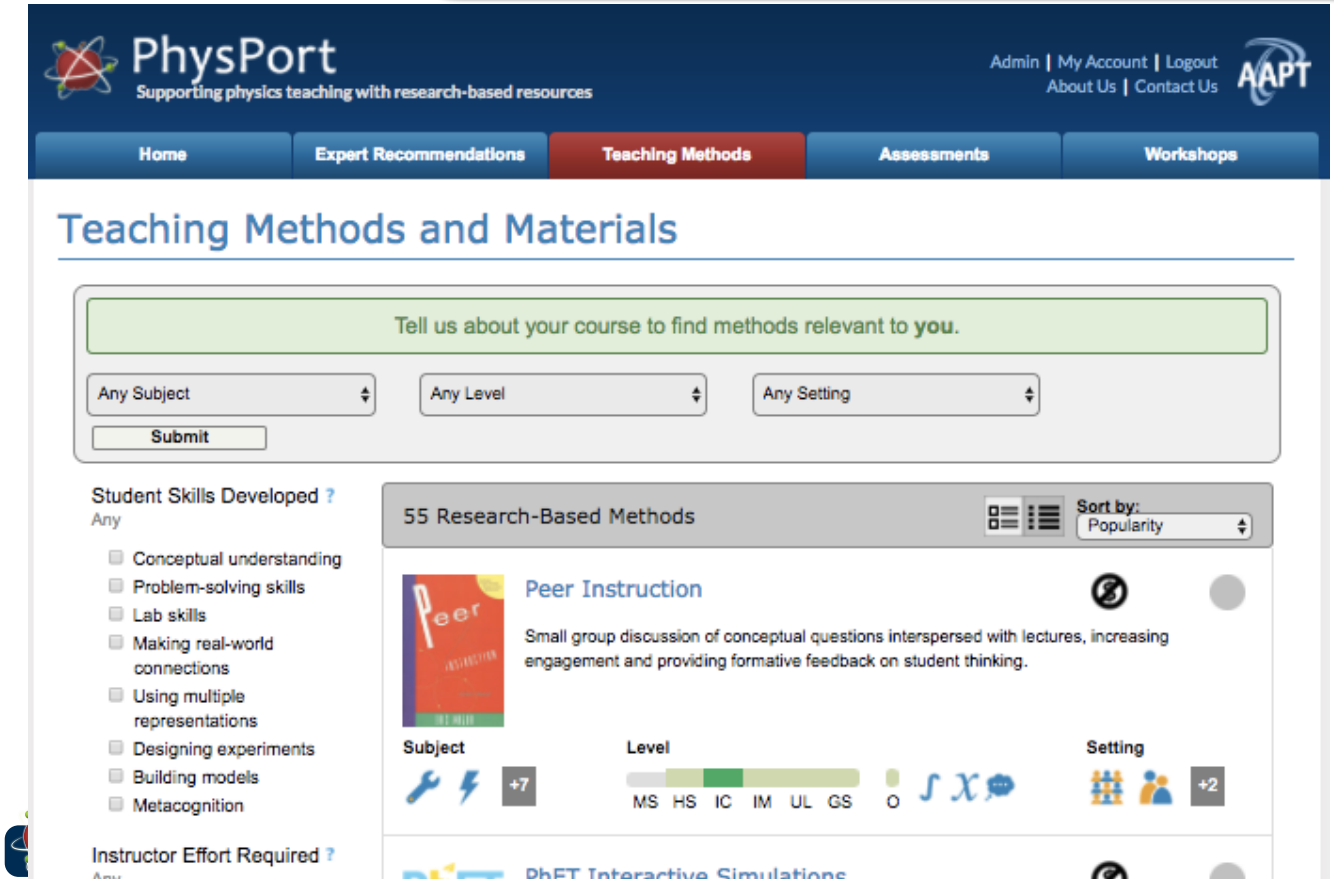
esayre@ksu.edu

smckagan@aapt.org

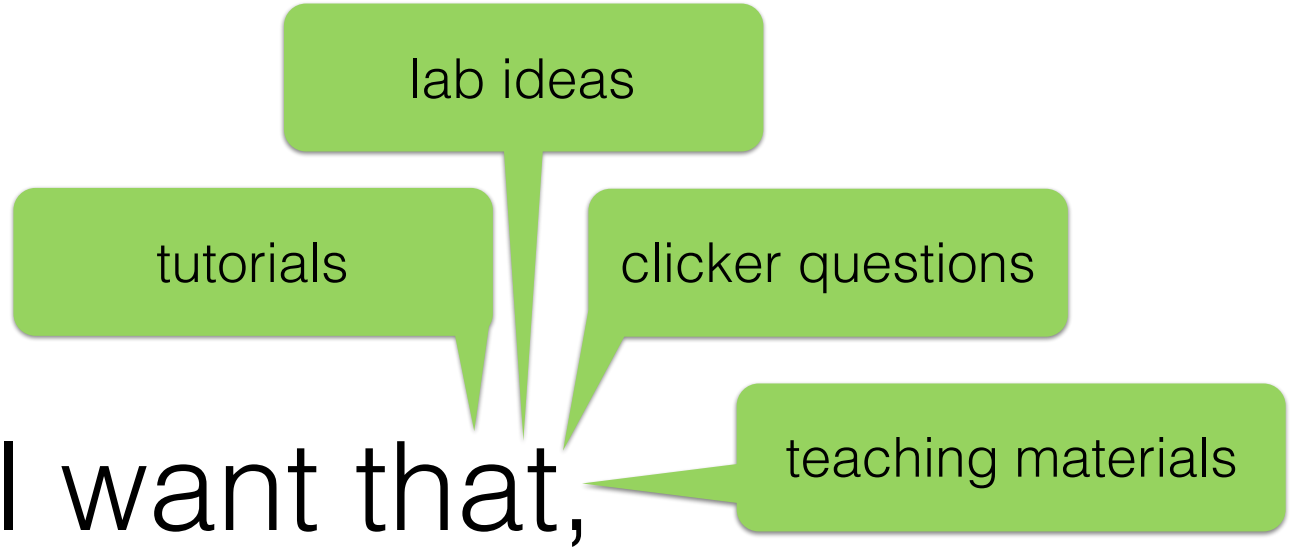
Teaching Methods

physport.org/methods/

How do I know which way to teach?



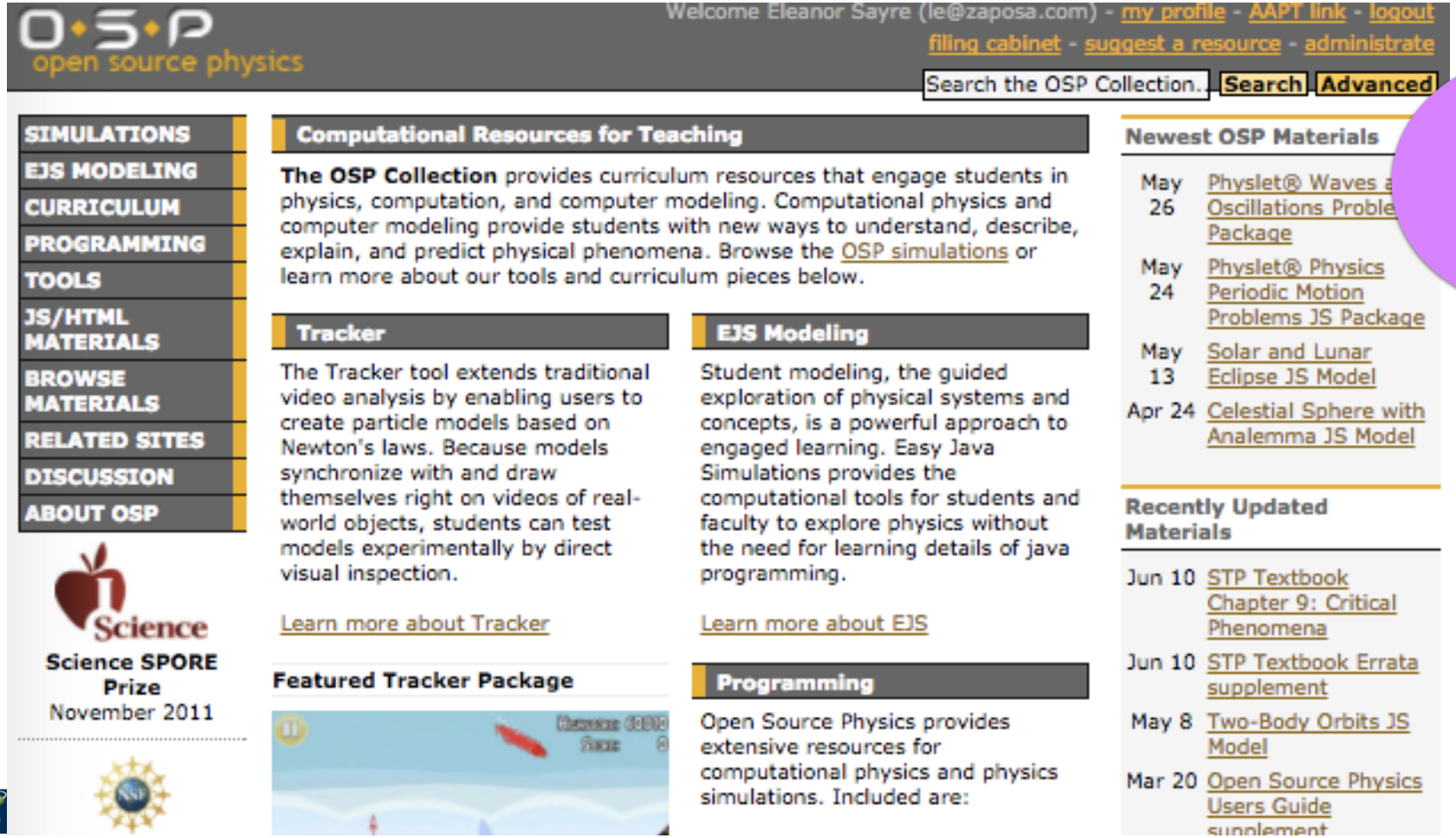
- Type of method
- Level & Setting
- Coverage & Topics
- Instructor Effort
- Research validation
- Compatible methods
- Similar methods
- More information



Now that I want that, where can I get it?

Open Source Physics

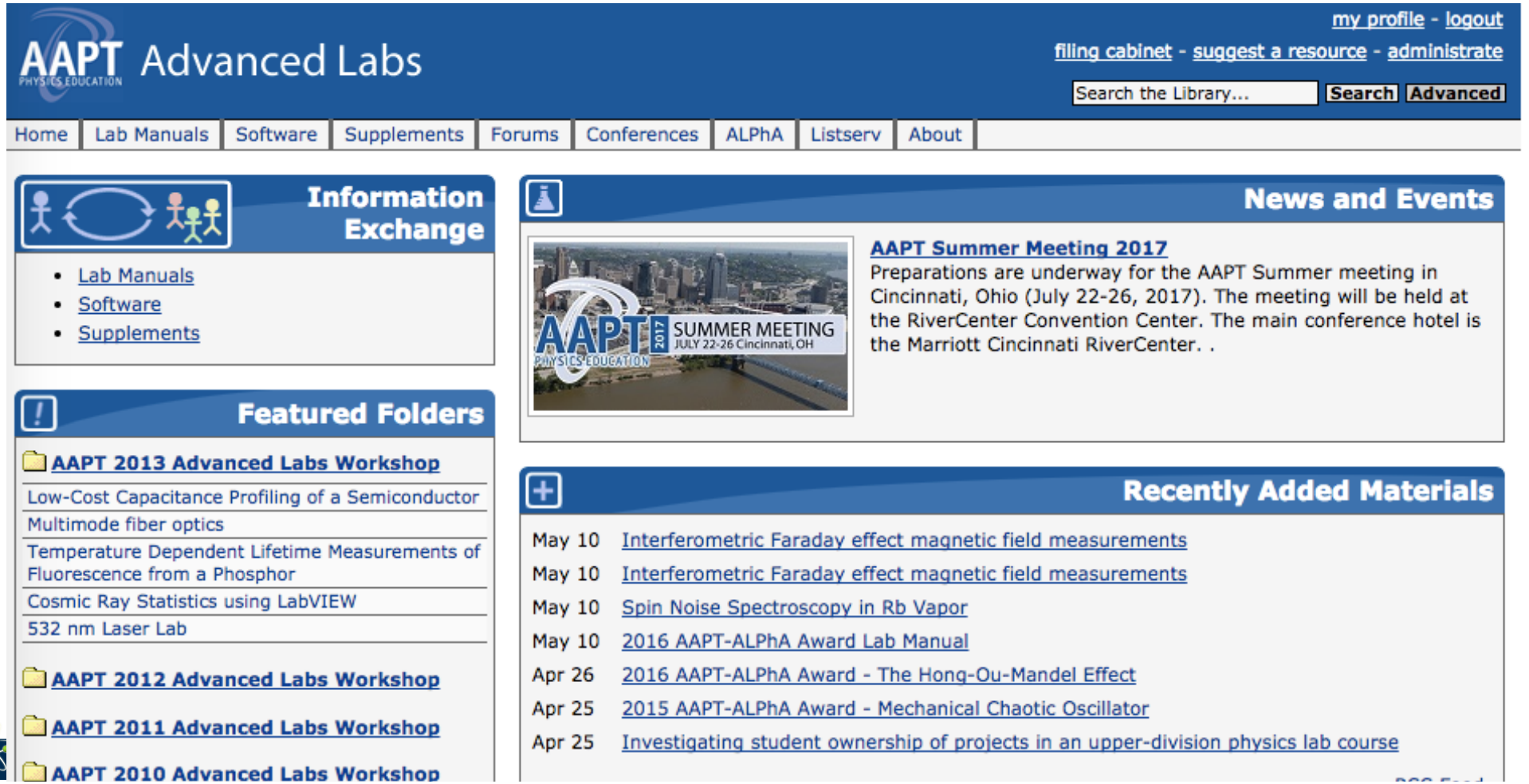
www.compadre.org/osp/



parallel session

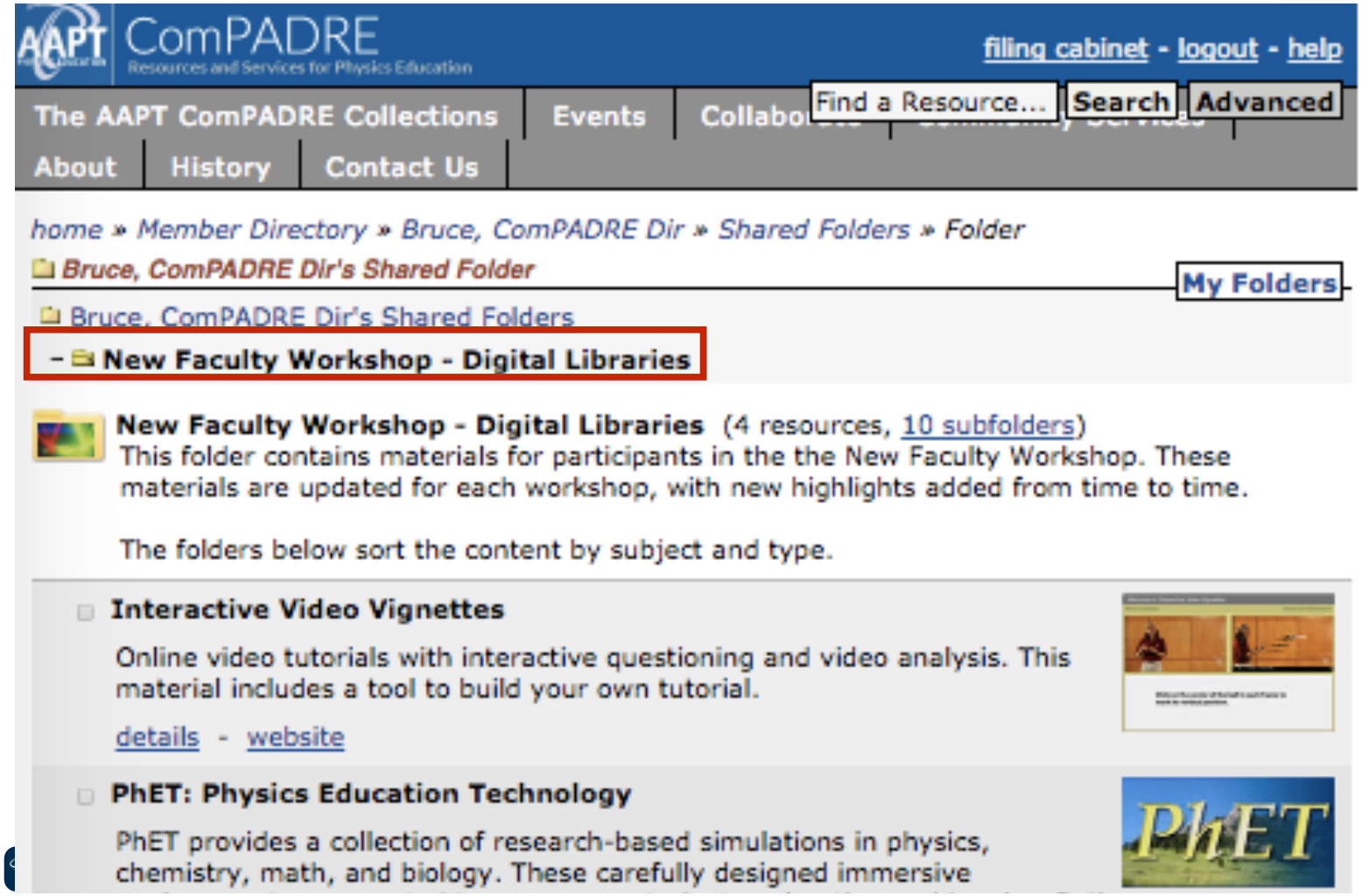
Advanced Labs

www.compadre.org/advlabs/



Filing cabinet

bit.ly/compadre-nfw



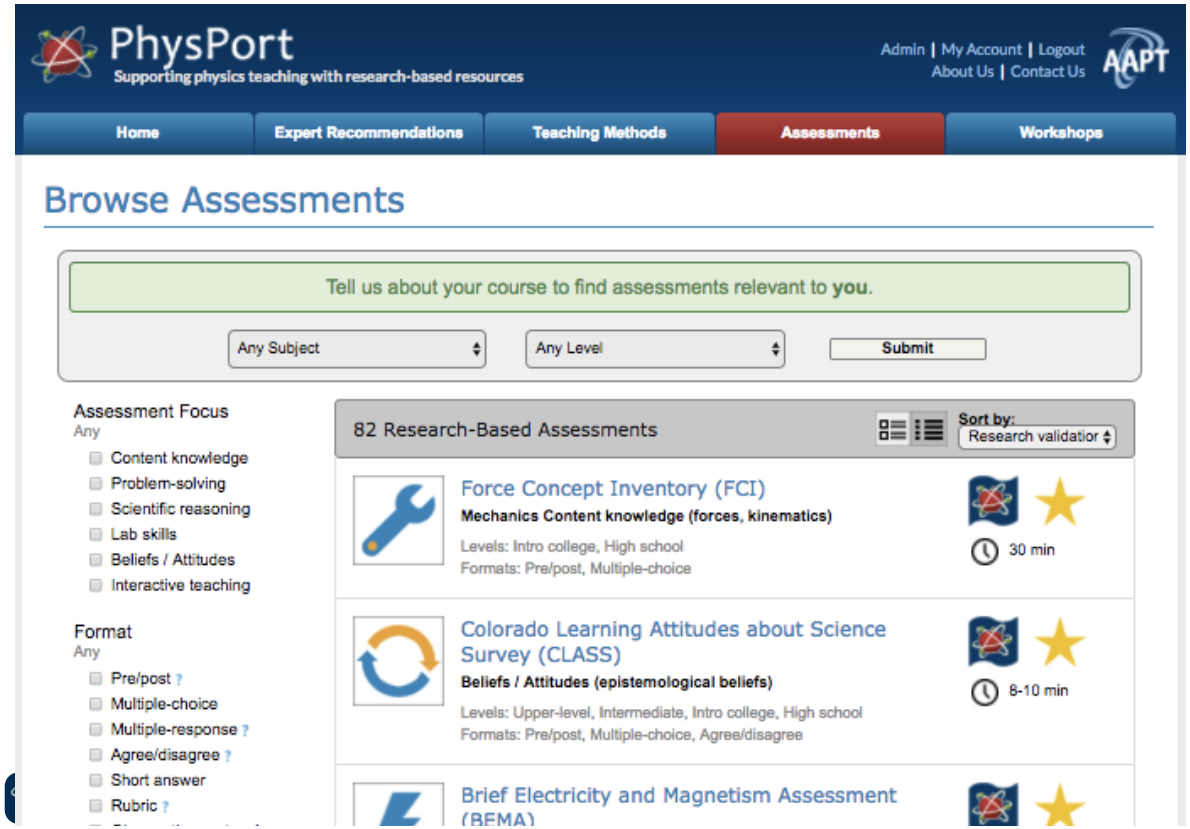
NFW collection

Make your own collections!

Assessment Resources

physport.org/assessments

How do I know if my students are learning?



These are:

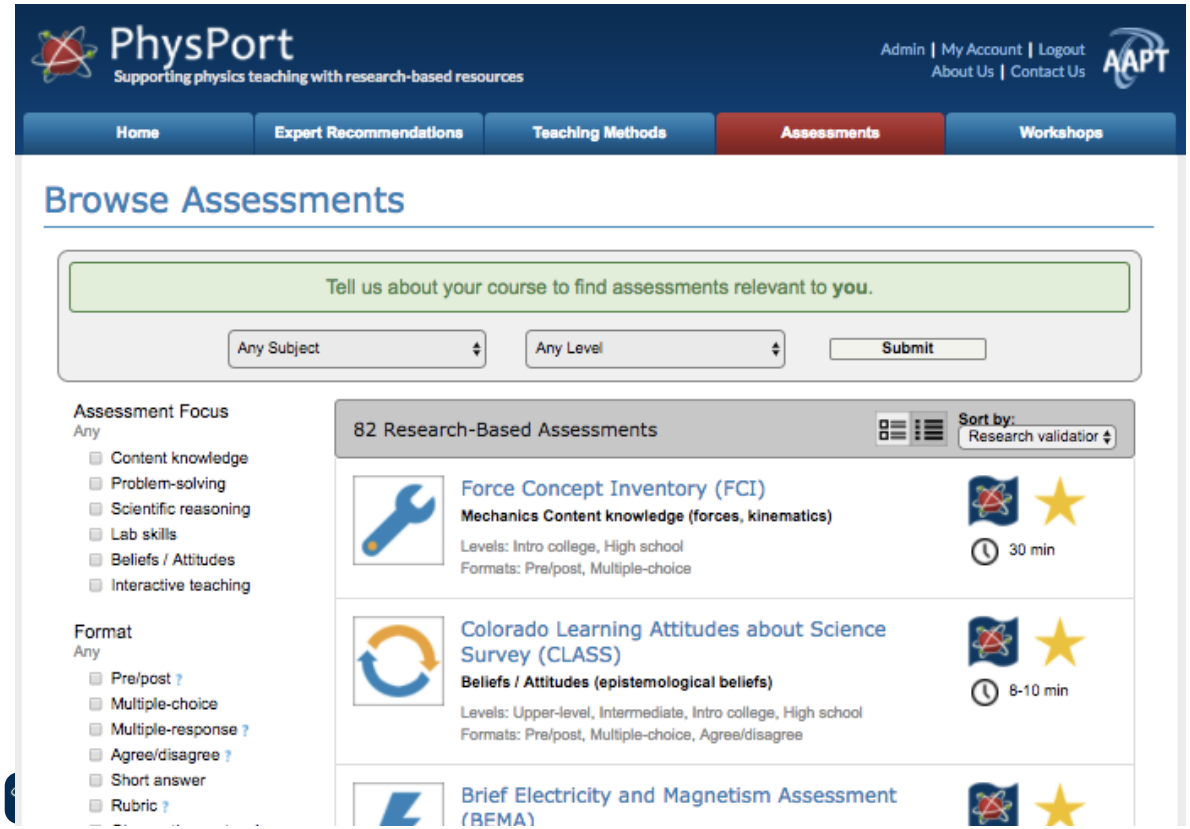
- Generally multiple-choice surveys
- Carefully crafted questions
- Conceptual topics across physics curriculum
- Additionally: beliefs, problem-solving skills, affect

80+ available

Assessment Resources

physport.org/assessments

How do I know if my students are learning?



- Search for RBAs
- Get administration details
- Sample questions & typical results
- Download RBAs
- Download usage guides

Verified educators!

For faculty and teaching staff

free, easy

Force Concept Inventory

Typical results

RESEARCH VALIDATION SUMMARY

Based on Research Into:

- ☑ **Student thinking**

Studied Using:

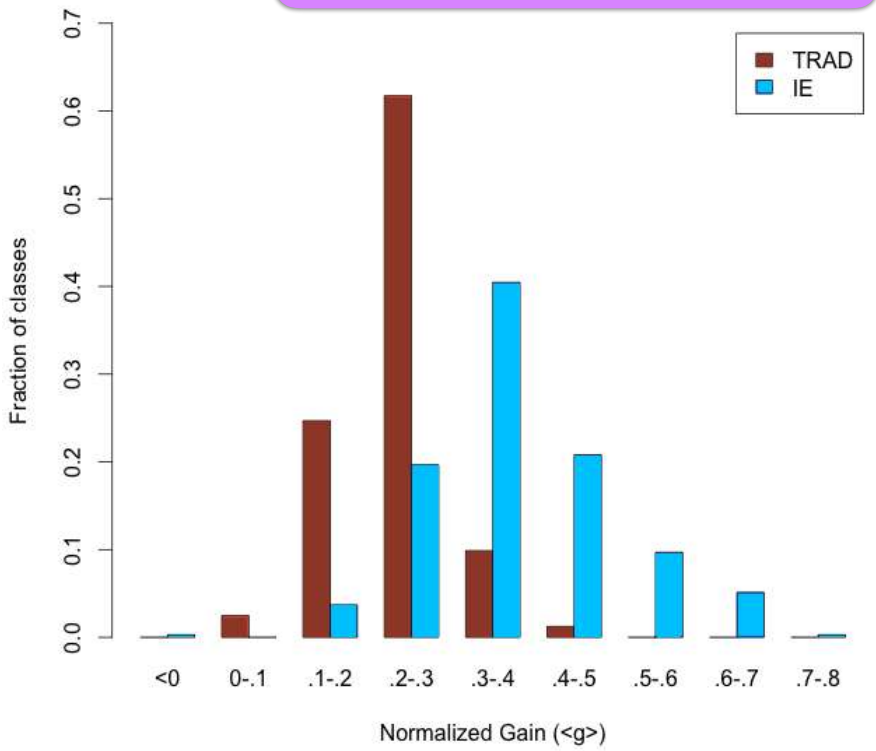
- ☑ **Student interviews**
- ☑ **Expert review**
- ☑ **Appropriate statistical analysis**

Research Conducted:

- ☑ **At multiple institutions**
- ☑ **By multiple research groups**
- ☑ **Peer-reviewed publication**

About half of the questions on the FCI come from an earlier test called the Mechanics Diagnostic Test (MDT). Questions on the MDT were developed using students ideas from open-ended responses. These questions were then reviewed by experts, refined through student interviews and given to over 1000 students. Statistical analysis of the reliability of the MDT was conducted and the pre- and post-test were found to be highly reliable. For those FCI questions not taken directly from the MDT, open-ended responses and responses given by students in interviews were compared to ensure the questions were being interpreted correctly. Since its release, over 50 studies have been published using the FCI at both the high school and college ncluding data on able is the study scores based on 00 students.

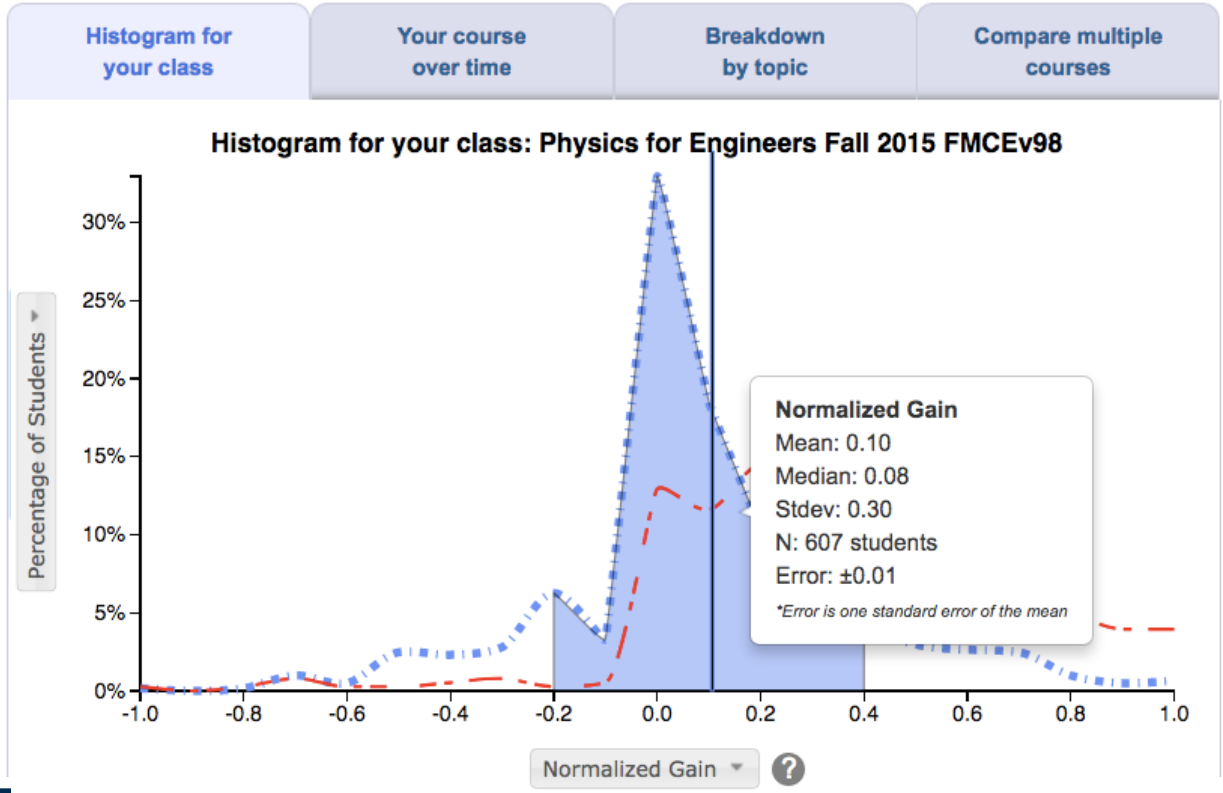
Research summary



Data Explorer

physport.org/DataExplorer

Visualize and compare your students' performance on research-based assessment instruments.



Upload your data

Explore your data

Download a report

Online workshops

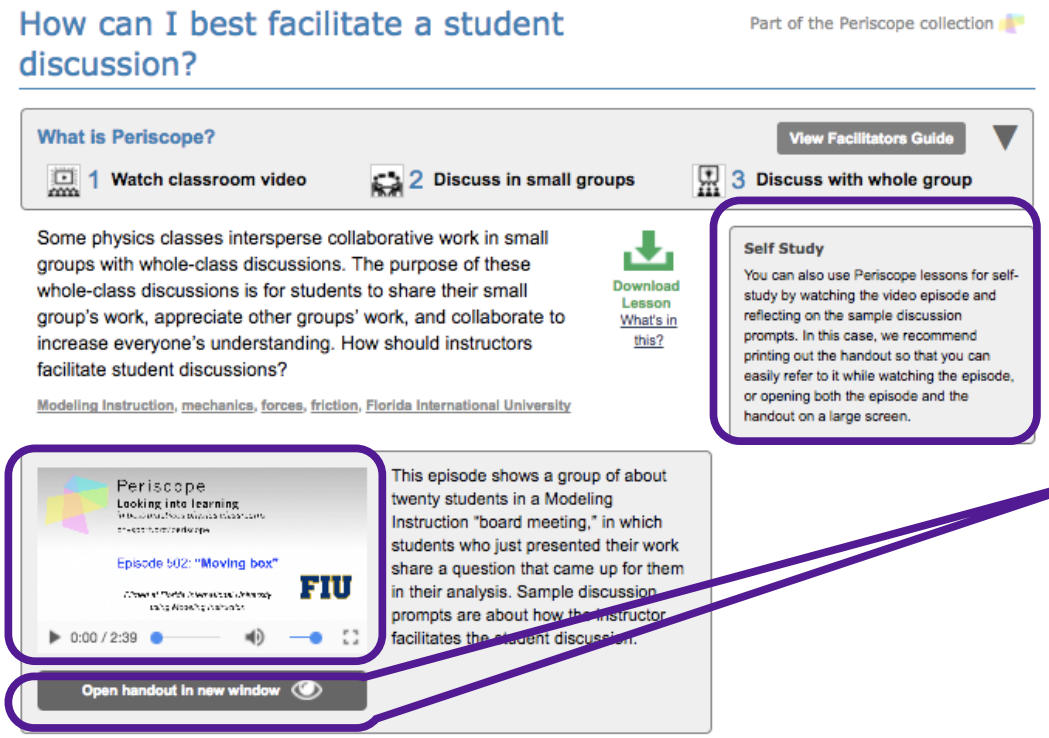
physport.org/workshops

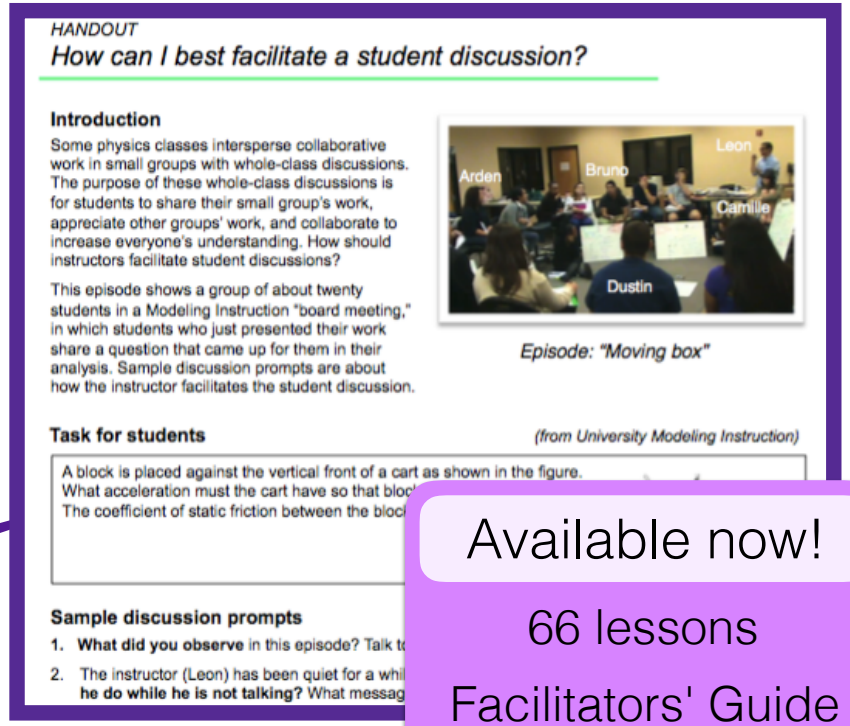
Video workshops for training teaching assistants and faculty professional development in best practices

Periscope

physport.org/periscope

Videos of students working with handouts for training TAs and faculty in best-practices.





Available now!

66 lessons

Facilitators' Guide

What do you want to do?

A. I have questions like "what's available for..." and "how do I...".
   I want to explore resources on PhysPort and ComPADRE on my device.

B. I want to try a Periscope lesson about
   "What instructor behaviors facilitate student learning?"

C. I want to have a discussion around questions like
   "What do we know about...". Please show me more data!

D. My brain is full and I want some time to process what we've done.

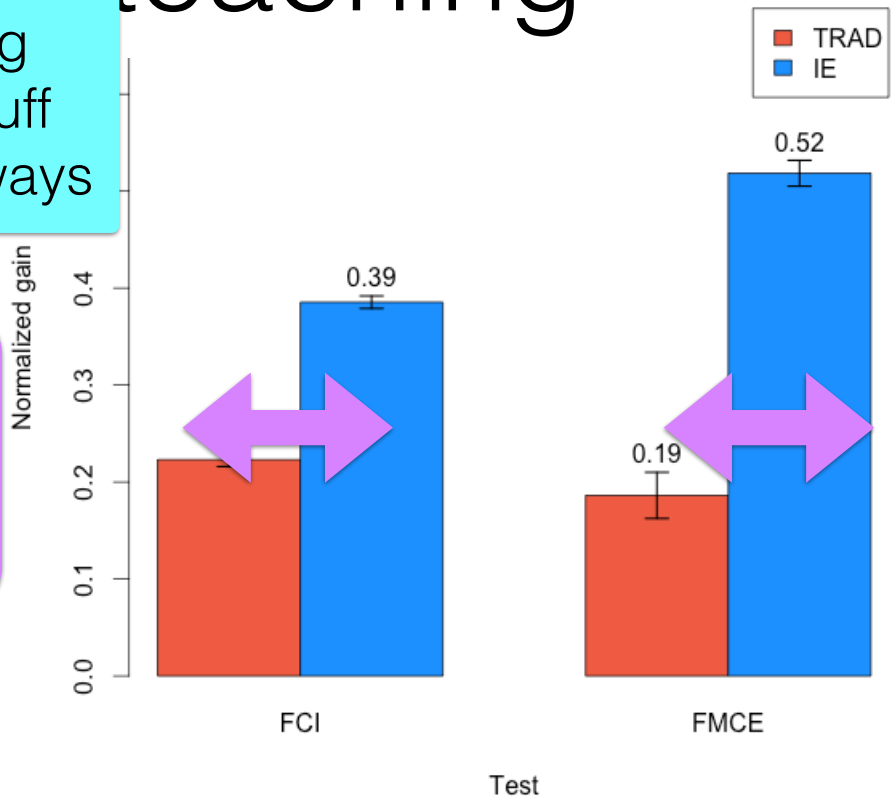
Data

Mechanics teaching

active learning
students do stuff
many different ways

Interactive
engagement
is better than
traditional lecture

chalk-and-talk
sage on the stage
cookbook labs



50,000 Students

Von Korff, J., *et al* (accepted). Secondary Analysis of Teaching Methods in Introductory Physics : a 50k - Student Study. American Journal of Physics

Mechanics teaching

active learning
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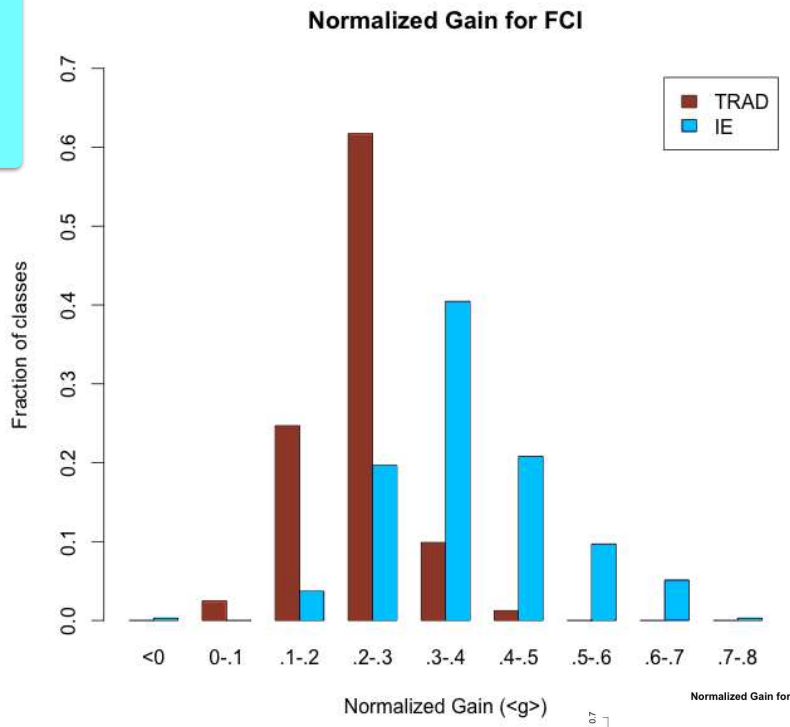
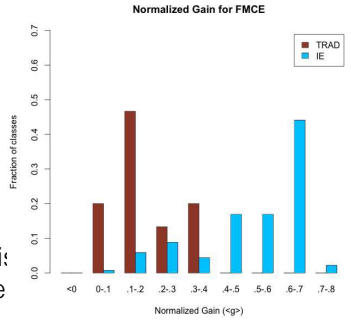
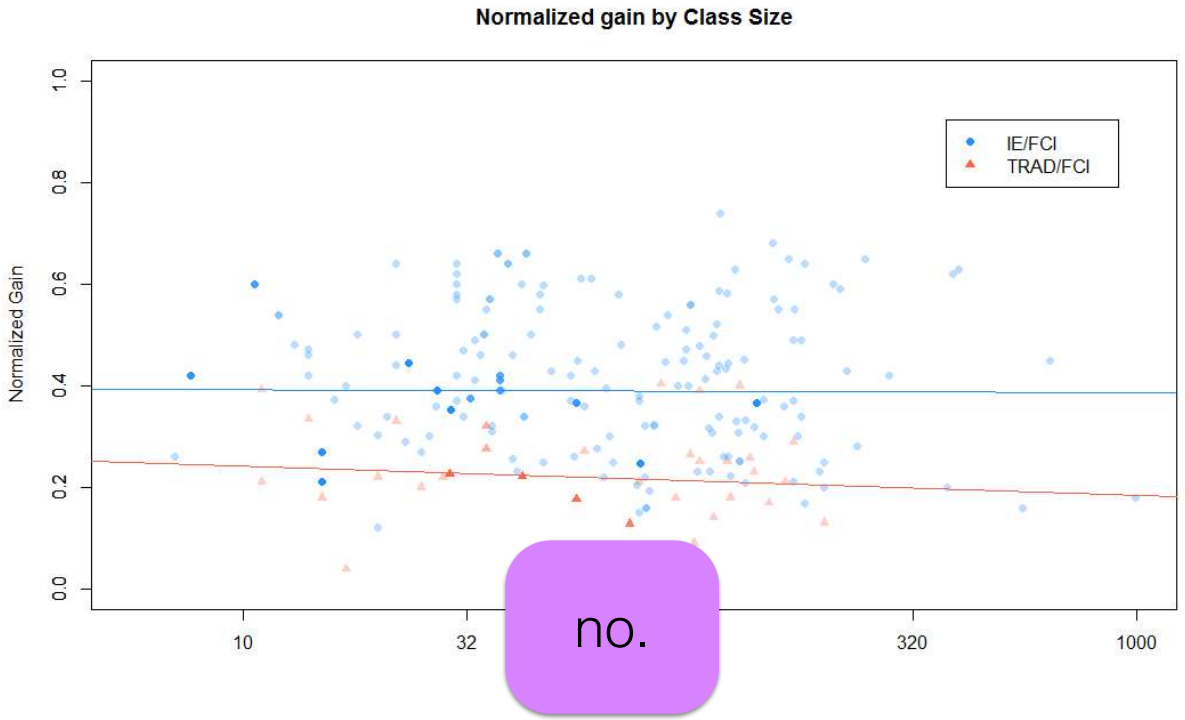




Von Korff, J., *et al* (accepted). Secondary Analysis
Introductory Physics : a 50k - Student Study. Ame

Does class size matter?

- Different sizes use different IE methods.
- Same trend for lecture and lab



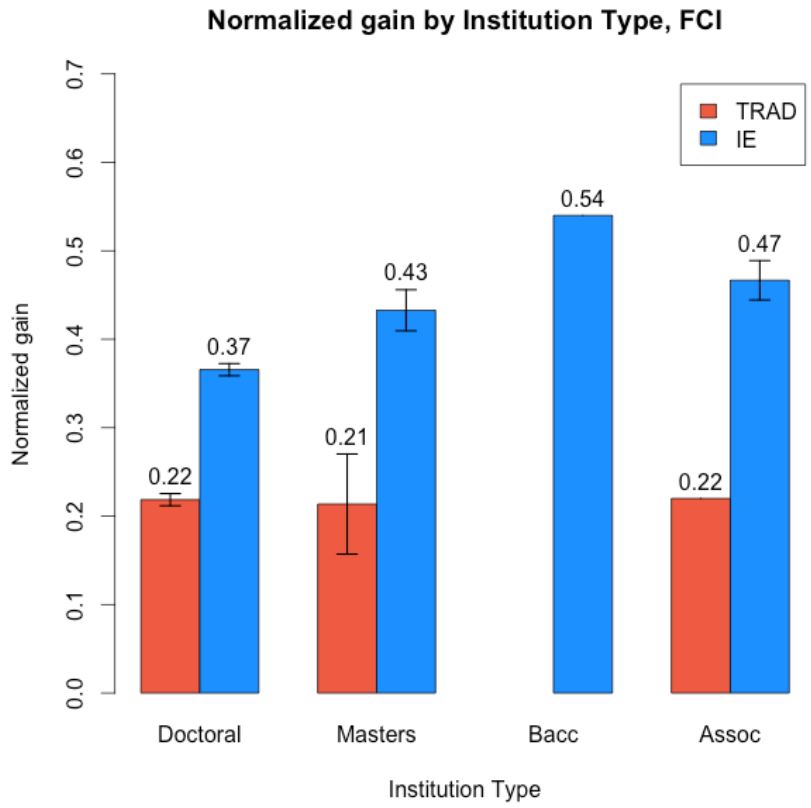
Von Korff, J., *et al* (2016). Secondary Analysis of Teaching Methods in Introductory Physics : a 50k - Student Study. American Journal of Physics

Does institution type matter?

- Reduced Carnegie classification
- Only US schools

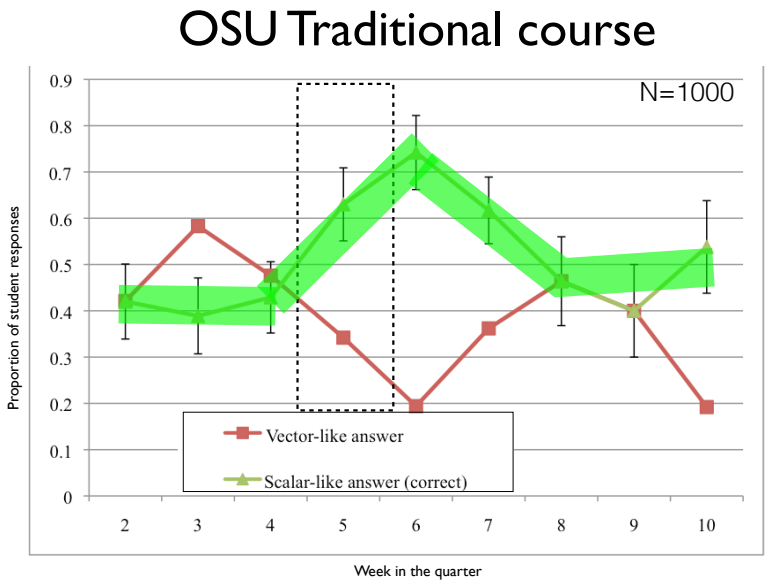
no.

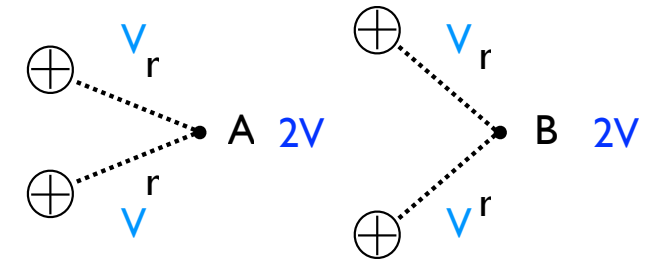
- Highly dependent on publishing effect
- Data are mostly Doc institutions.



Von Korff, J., *et al* (2016). Secondary Analysis of Teaching Methods in Introductory Physics : a 50k - Student Study. American Journal of Physics

Different teaching methods



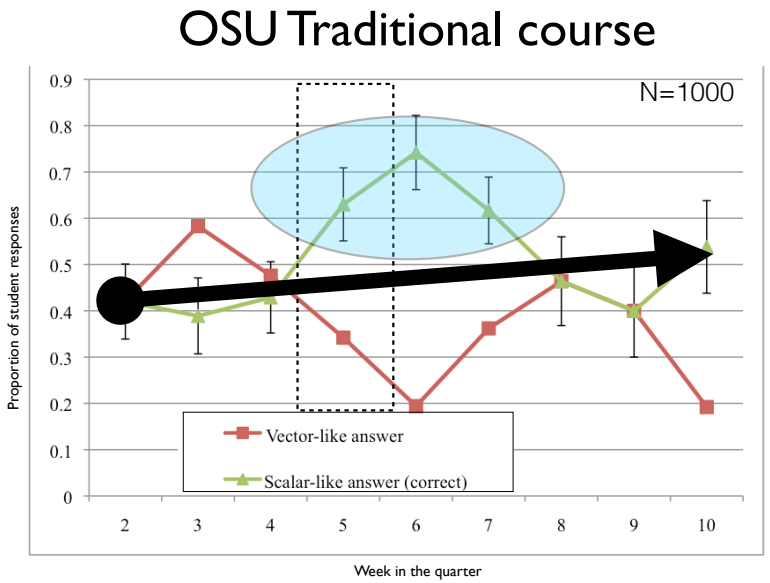


At which point is the Electric Potential greater?

$$V_A = V_B$$

Franklin, S.V., Sayre, E.C., and J. Clark (2015) "Traditionally taught students learn; actively-engaged students remember" *AJP*

Different teaching methods



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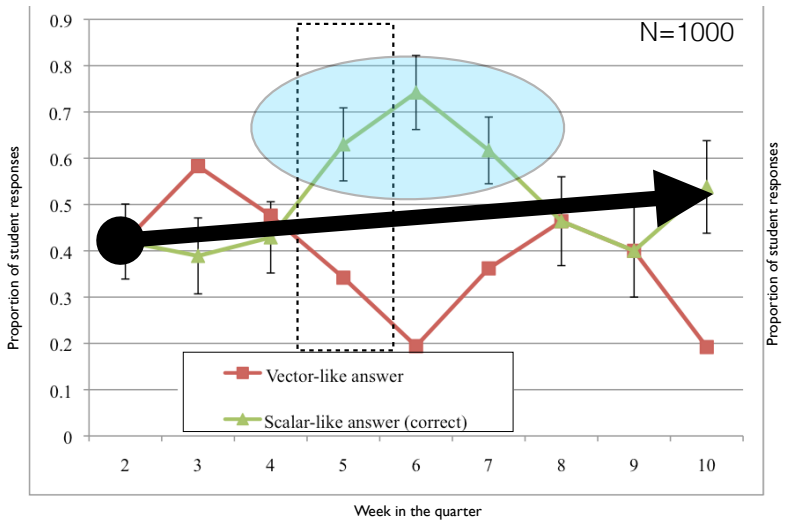
Franklin, S.V., Sayre, E.C., and J. Clark (2015) "Traditionally taught students learn; actively-engaged students remember" *AJP*

Different teaching methods

OSU Traditional course



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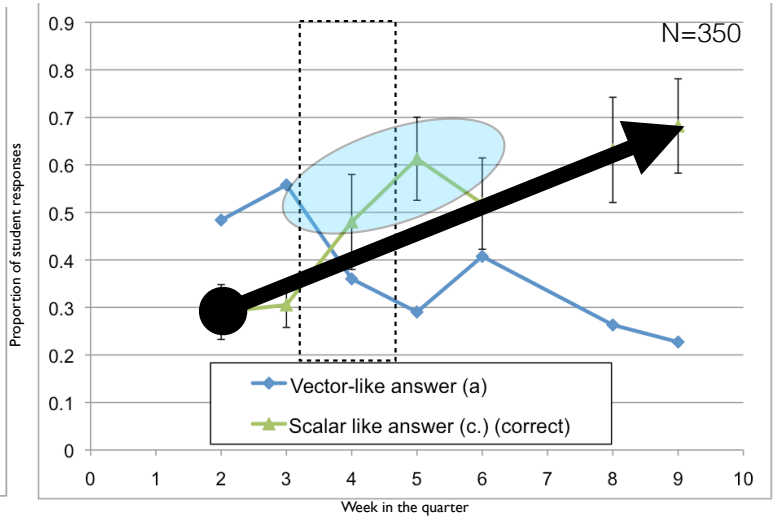
RIT Workshop course



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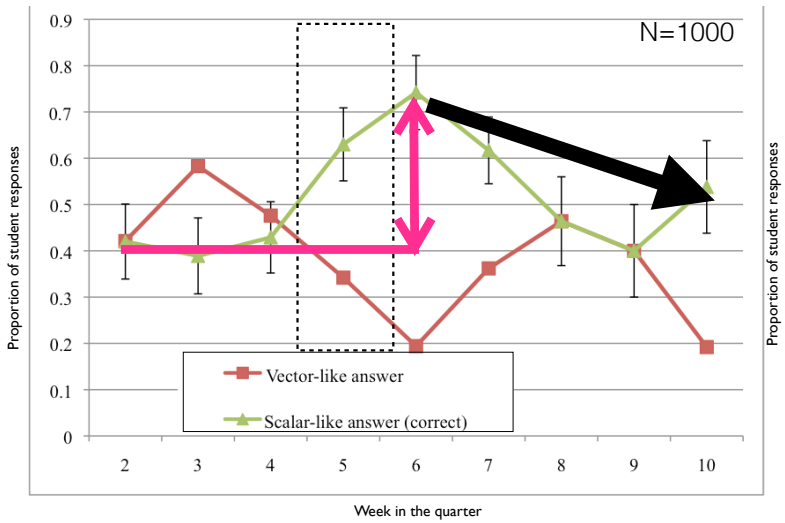
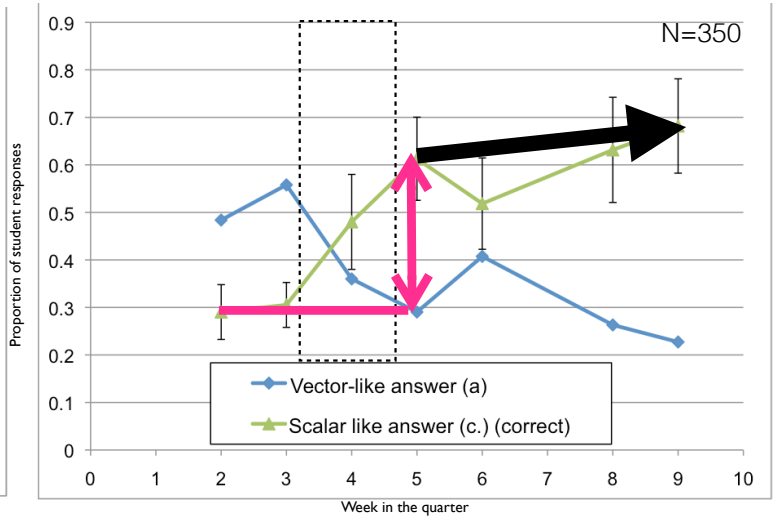
Franklin, S.V., Sayre, E.C., and J. Clark (2015) "Traditionally taught students learn; actively-engaged students remember" *AJP*

Different teaching methods

OSU Traditional course



RIT Workshop course



Both classes learn the same amount during instruction, but the reformed class fails to forget afterwards.

Franklin, S.V., Sayre, E.C., and J. Clark (2015) "Traditionally taught students learn; actively-engaged students remember" *AJP*

Surveys of student beliefs about physics

- How much do students' beliefs align with physicists?
- Measure **shifts** in physicist-like belief
- CLASS, MPEX

12 beliefs and attitudes surveys available on PhysPort!

Survey

1. A significant problem in learning physics is being able to memorize all the information I need to know.

Strongly Disagree	1	2	3	4	5	Strongly Agree

2. When I am solving a physics problem, I try to decide what would be a reasonable value for the answer.

Strongly Disagree	1	2	3	4	5	Strongly Agree

3. I think about the physics I experience in everyday life.

Strongly Disagree	1	2	3	4	5	Strongly Agree

4. It is useful for me to do lots and lots of problems when learning physics.

Strongly Disagree	1	2	3	4	5	Strongly Agree

5. After I study a topic in physics and feel that I understand it, I have difficulty solving problems on the same topic.

Strongly Disagree	1	2	3	4	5	Strongly Agree

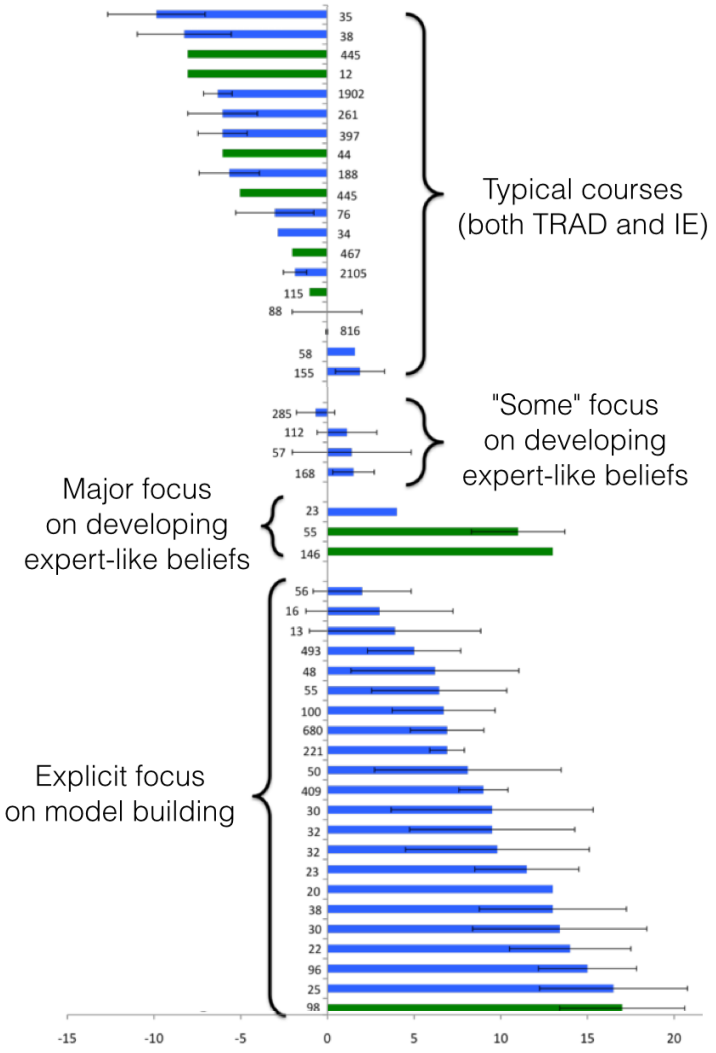
Adams, W. K., et al (2006). New instrument for measuring student beliefs about physics and learning physics: The Colorado Learning Attitudes about Science Survey. *Physical Review Special Topics - Physics Education Research*, 2(1), 010101.

Student Beliefs

- 24 studies
- Teaching method, class size, student population

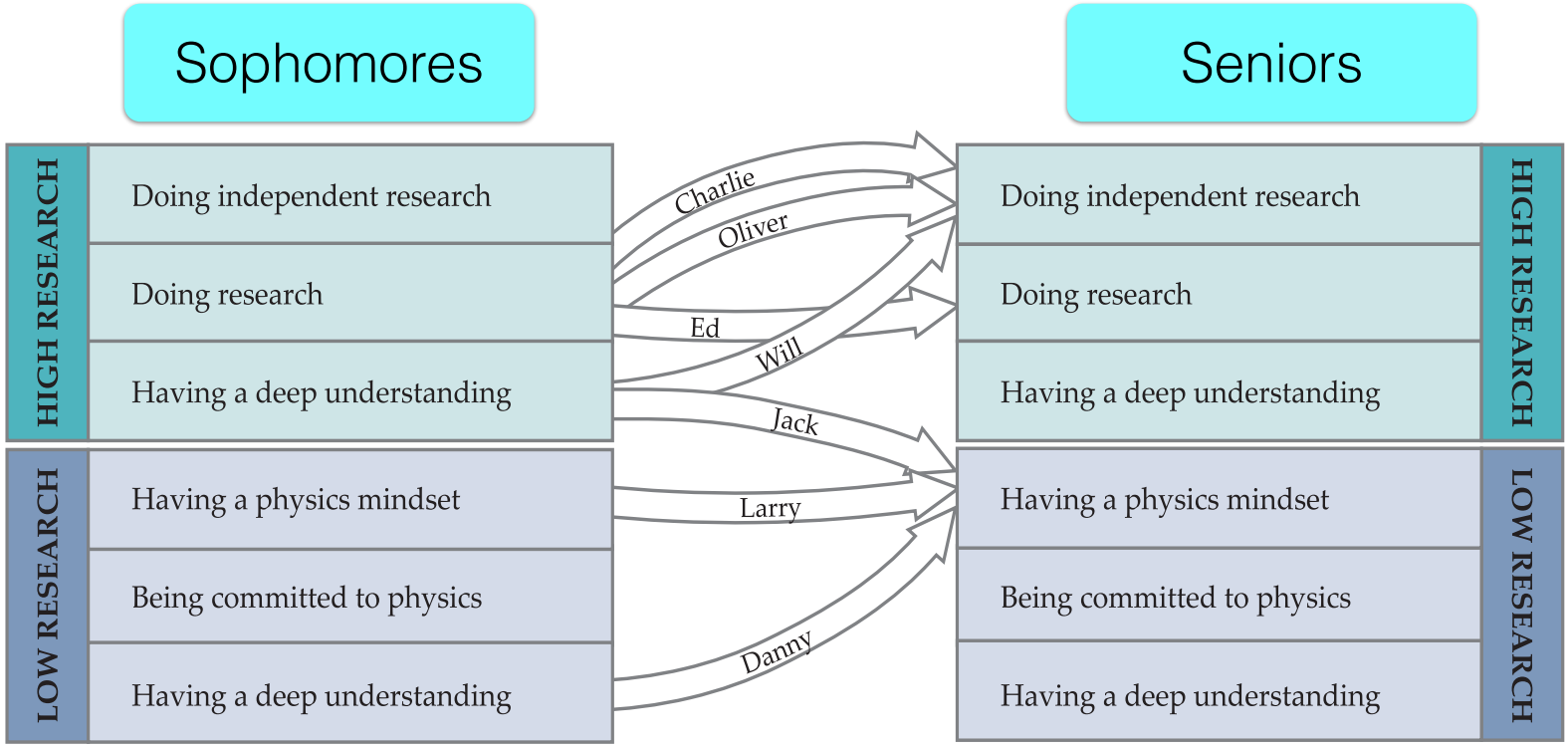
"Ordinary" IE is not enough.

Focus on connecting ideas and observations. ("model building")



Madsen, A. M., McKagan, S. B., & Sayre, E. C. (2015). How Physics Instruction impacts students' beliefs about learning physics. *Physical Review Special Topics — Physics Education Research*.

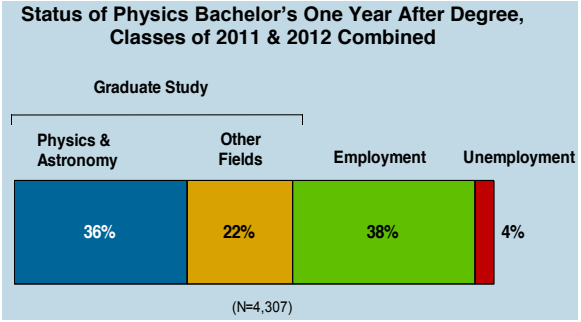
What are physicists?



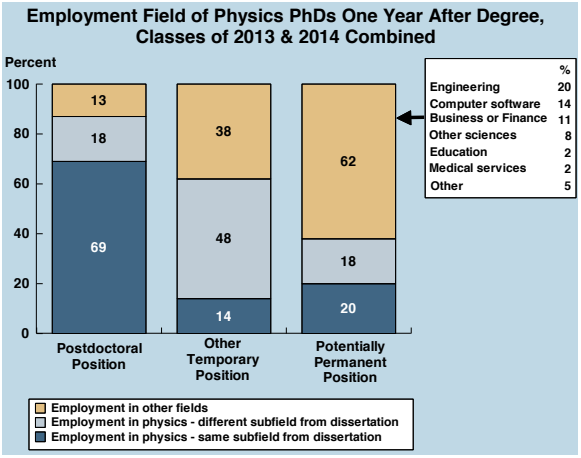
Irving, P. W., & Sayre, E. C. (2016). Developing physics identities. *Physics Today,* 69 (May).

Preparing non-faculty physicists

We are the 1%.



AIP Statistical Research

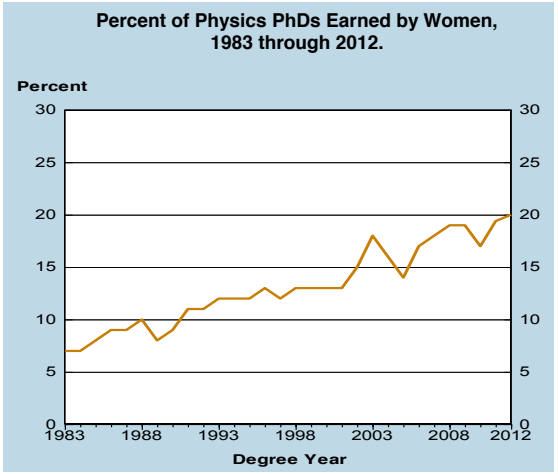


AIP Statistical Research

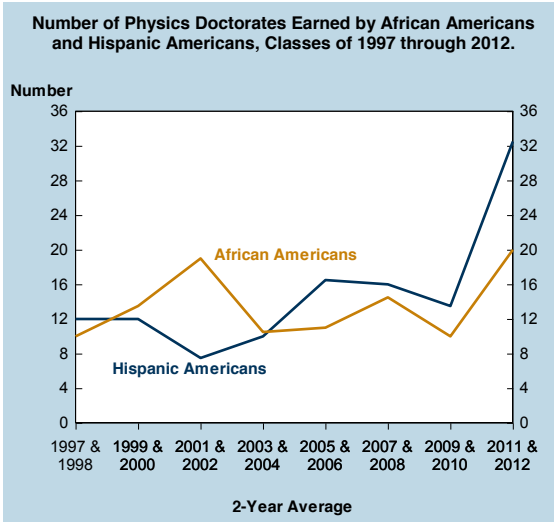
Preparing non-faculty physicists

We are the 1%.

Excluding non-white, non-cis, non-male physicists



AIP Statistical Research



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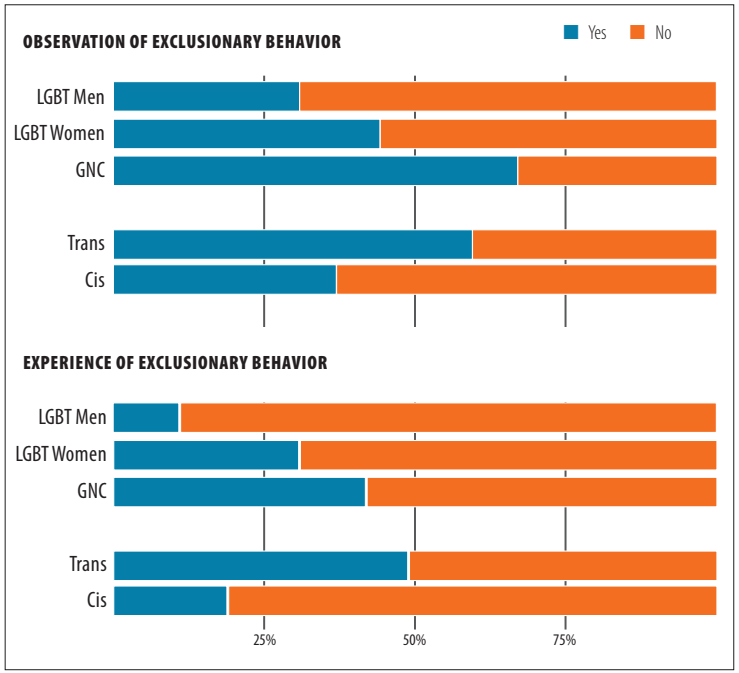

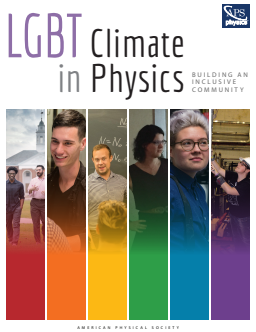

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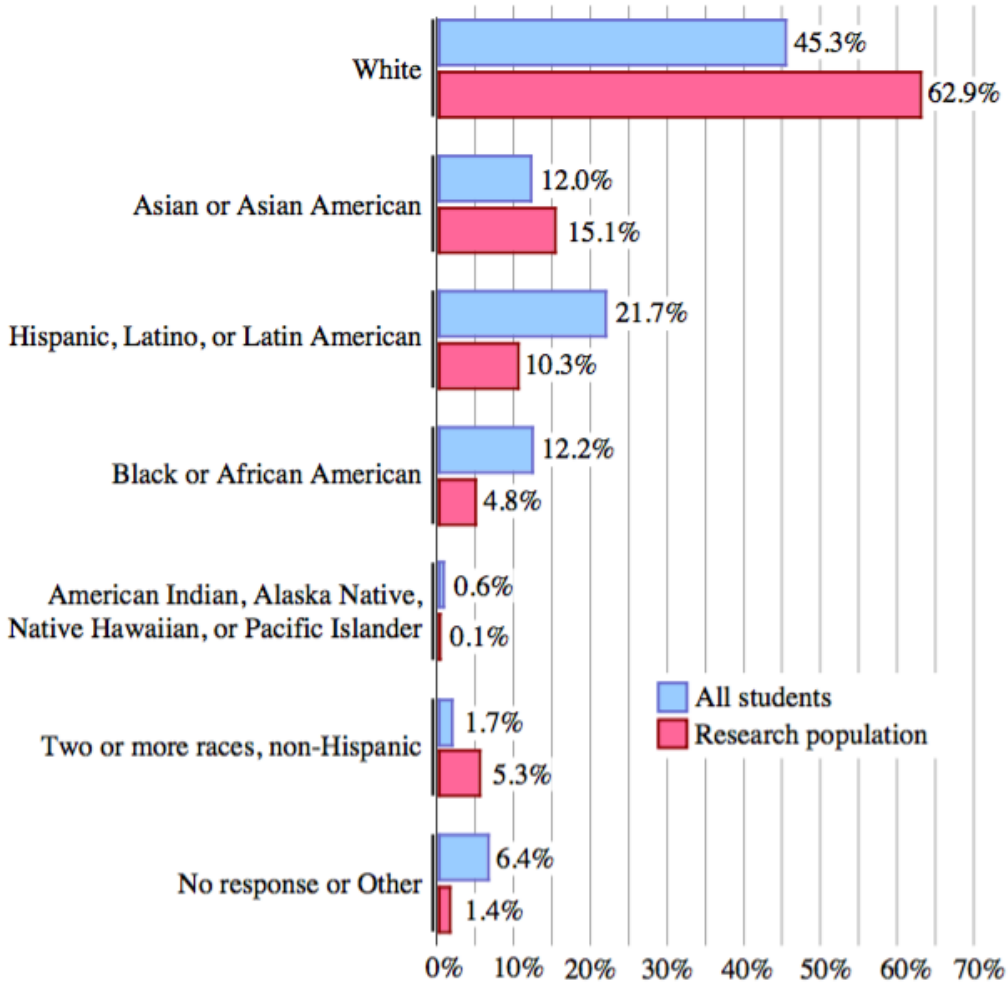


Cid and Kanim, arXiv:1710.02598

Where are physics students?

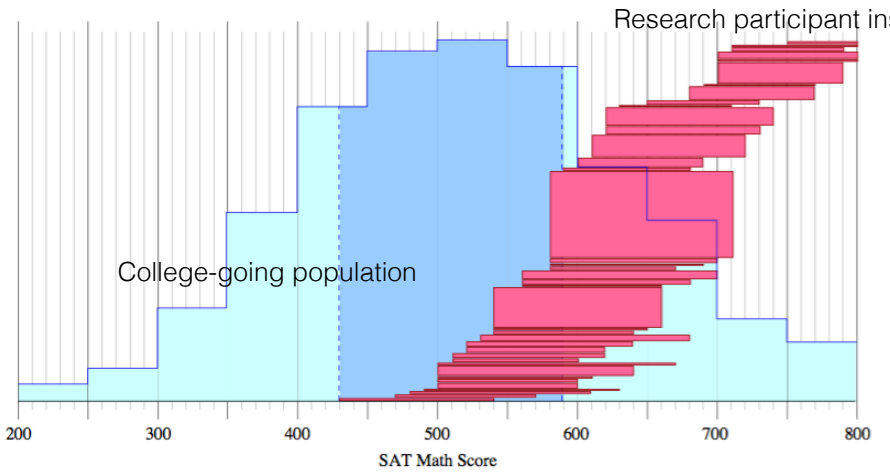
- 1/3 of all physics majors come from Bacc departments
- 2/3 of physics departments are Bacc only.

Introductory physics course enrollments at physics departments, academic year 2007-08.

Highest physics degree offered by department	Calculus Based	Algebra Based	Conceptual
Bachelor's	49,000	48,000	30,000
Master's	18,000	18,000	13,000
PhD	112,000	87,000	32,000
Total	179,000	153,000	75,000

We estimate that more than 215,000 students were enrolled in a physics or physical science course in a two-year college during the

AIP Statistical Research



Cid and Kanim, arXiv:1710.02598

Gender gaps in learning physics

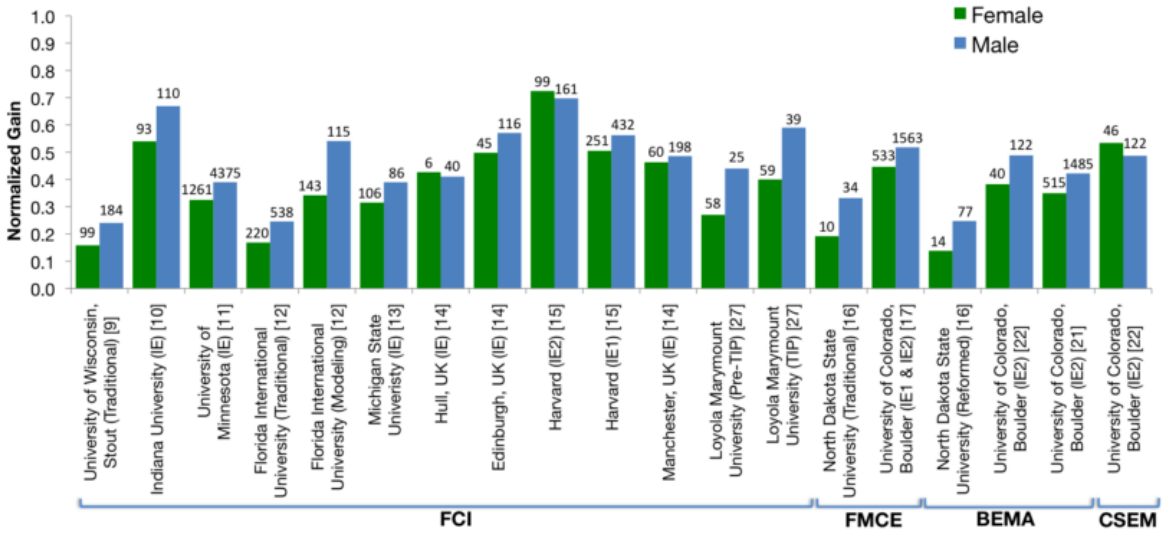
Men outperform women on RBAs

Mechanics: Men = .43; Women = .37
E&M: Men = .42; Women = .36

This is smaller than the Trad / IE gap.

There is no single factor which causes or maintains the gap.

Bias can be subtle. Need process measures.

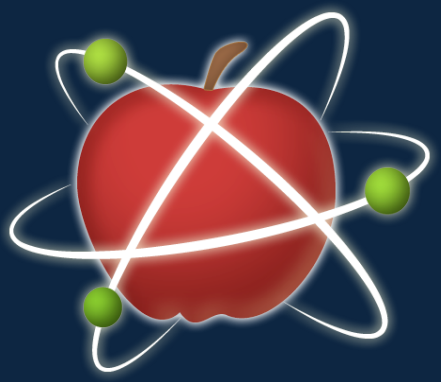


Madsen, A., McKagan, S. B., & Sayre, E. C. (2013). Gender gap on concept inventories in physics: What is consistent, what is inconsistent, and what factors influence the gap? *Physical Review Special Topics - Physics Education Research*, 9(2), 020121.

PhysPort.org Eleanor Sayre, esayre@ksu.edu

Gender gap: causes

Type of factor	Examples	Explains part of gap?
Background and preparation	high school GPA, major, physics1 grade, years of physics	no
Other assessment	other RBAI scores, grade in class	yes
Teaching method	Level of IE, Studio physics, etc	inconclusive or no.
Sociocultural factors	stereotype threat, beliefs inventories, locus of control	often yes.
Question construction	Item analysis, everyday vs. feminine context	no



PhysPort

Supporting physics teaching
with research-based resources

physport.org

Organizing your knowledge

- Synthesis research
- Expert recommendations
- Teaching method search
- Assessment search
- Data explorer
- Online workshops

PhysPort can help.

PhysPort

Supporting physics teaching with research-based resources

physport.org

KSUPER

perg.phys.ksu.edu

Learn about better teaching!

Search for teaching methods

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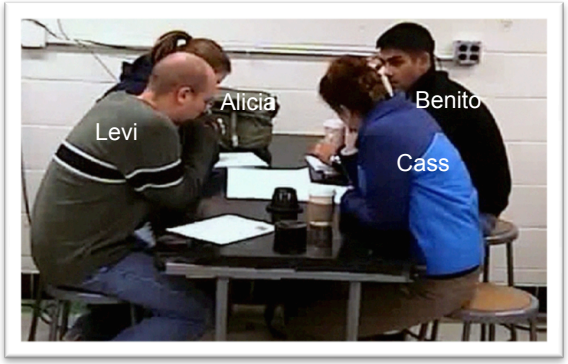
HANDOUT

What instructor behaviors facilitate student learning?

Introduction

In classes centered on collaborative group work, one of the instructor's most important jobs is to create an environment in which students express their physics ideas, engage with each other's reasoning, and get closer to a scientific understanding. What instructor behaviors best support these goals for students?

This episode shows an instructor in a tutorial who listens to a group of students express their ideas, then helps them clarify their different arguments. Sample discussion prompts are about what features of the interaction may have helped to make it successful.



Episode: "Depth"

Task for students

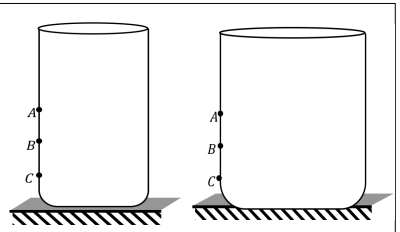
(from Open Source Tutorials in Physics Sense-Making)

Two containers with small holes in their sides are filled to the brim.

A. Using a dashed line, sketch the path you think the water from each hole will take when it leaves the container.

B. Where do you think the water will squirt out the hardest, and where the most weakly (or will it be equal)?

C. What causes the water to squirt out more strongly from some places than from others? Explain the idea that you think should guide your predictions from now on.



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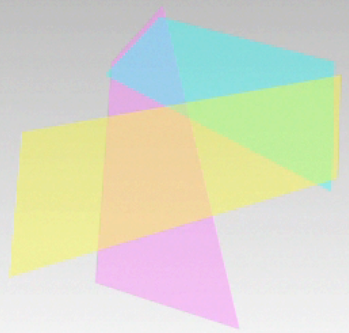

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Looking into learning

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Episode 101: **"Depth"**

Filmed at the University of Maryland
using Open Source Tutorials

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Supported in part by
NSF Grant No. 1323699

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- What do you notice? Talk with the people near you.
- What does Levi do to draw out students' ideas?

Sample discussion prompts

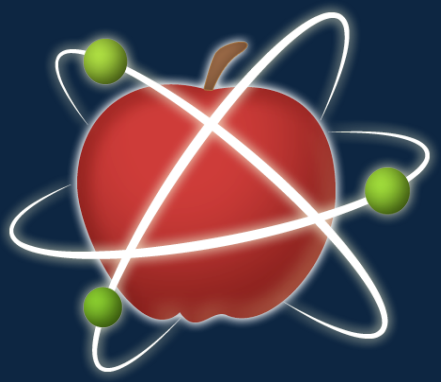
1. **What did you notice** in this episode? Talk to your neighbor about what you noticed.
2. The first step in effectively facilitating student learning is to find out where the students are coming from. What does Levi (the instructor) **say** that gets his students to articulate their ideas?
3. What does Levi **do (nonverbally)** to support the students in expressing themselves?
4. It can be tricky for an instructor to **draw out both sides of a contradictory argument without embarrassing anyone.** What specific strategies or behaviors does Levi use to keep everyone in the game?
5. **What instructor behaviors facilitate student learning,** as suggested in

Transcript

Available now!

66 lessons

Facilitators' Guide



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