

PhysPort

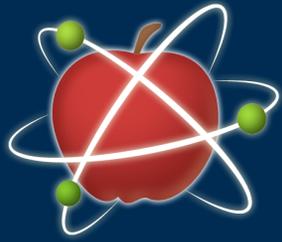
Eleanor C Sayre,
Sam McKagan,
Adrian M Madsen

New Faculty Workshop
18 November 2016

esayre@ksu.edu



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



PhysPort

Supporting physics teaching
with research-based resources

What is PhysPort?

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

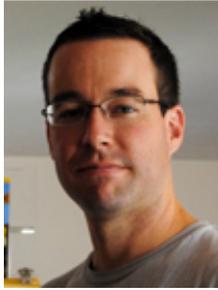
www.physport.org



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

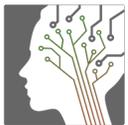


Ellie Sayre (*Research Director*)

Bill Hsu (*development lead*)

Eugene Vasserman (*security lead*)

Josh Weese (*senior developer*)



Cognition Technology



Sandy Martinuk

Alex Bell

(*User Experience*)

Periscope Specialists



Rachel Scherr

Stephanie Chasteen

How do you know if students are learning?

Assessment is a gateway drug

Good teaching and assessment are important.

How to teach better?

How to help students learn more?



Faculty professional development

New Faculty Workshop

Periscope

PER can help.

Research-Based Assessments

Research-based teaching methods

Embedded in curricula

Assessment instruments

Published curricula

Curricular elements



Developer websites

Ask a colleague

Attend a workshop

PER resources are scattered.

How to compare teaching methods?

Which assessment should I use?

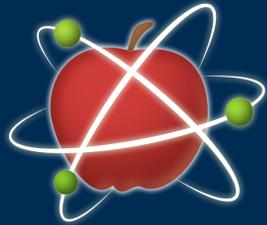
What works best for my context?

How do I support diverse learners?

course

program

PhysPort can help.



PhysPort

PhysPort can help.

Finding
information
and advice

Supporting physics teaching
with research-based resources

Changing
teaching
practices

Synthesis
research

Faculty-centered
online resources

Synthesis research

Interpret the results of diverse PER studies

Weighted combination of data from published studies

More robust than single study

Vulnerable to publishing bias

100,000 students

Madsen, McKagan, & Sayre (2013). Gender gap on concept inventories in physics: What is consistent, what is inconsistent, and what factors influence the gap? *PhysRevST-PER*

Madsen, McKagan, & Sayre (2015). How Physics Instruction impacts students' beliefs about learning physics. *PhysRevST-PER*

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



What are Research-based Assessments?

Force Concept Inventory (FCI)

Force & Motion Conceptual Evaluation (FMCE)

and 80+ more

These are:

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

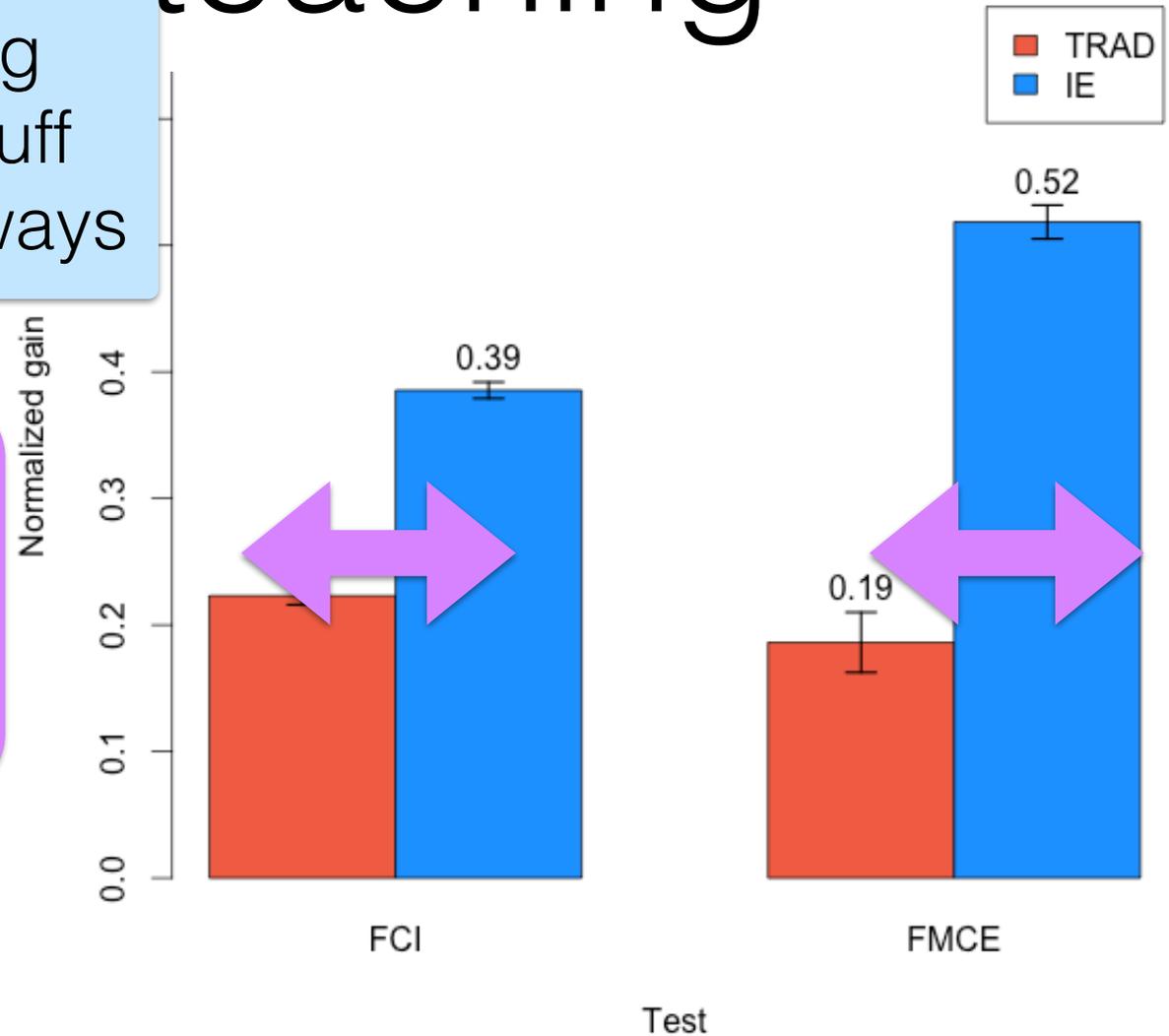


Mechanics teaching

active learning
students do stuff
many different ways

Interactive
engagement
is better than
traditional lecture

chalk-and-talk
sage on the stage
cookbook labs



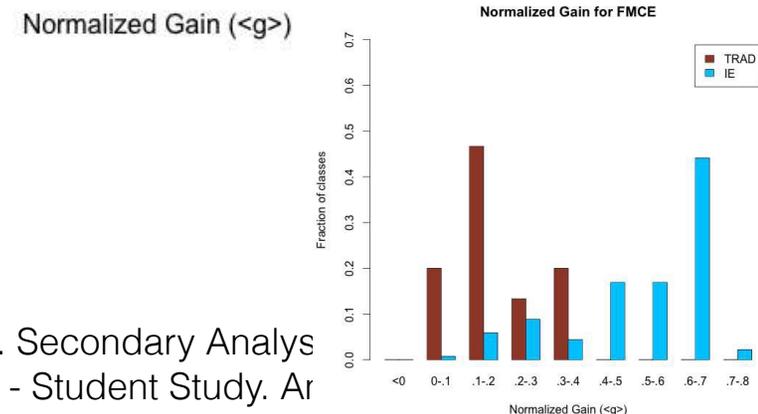
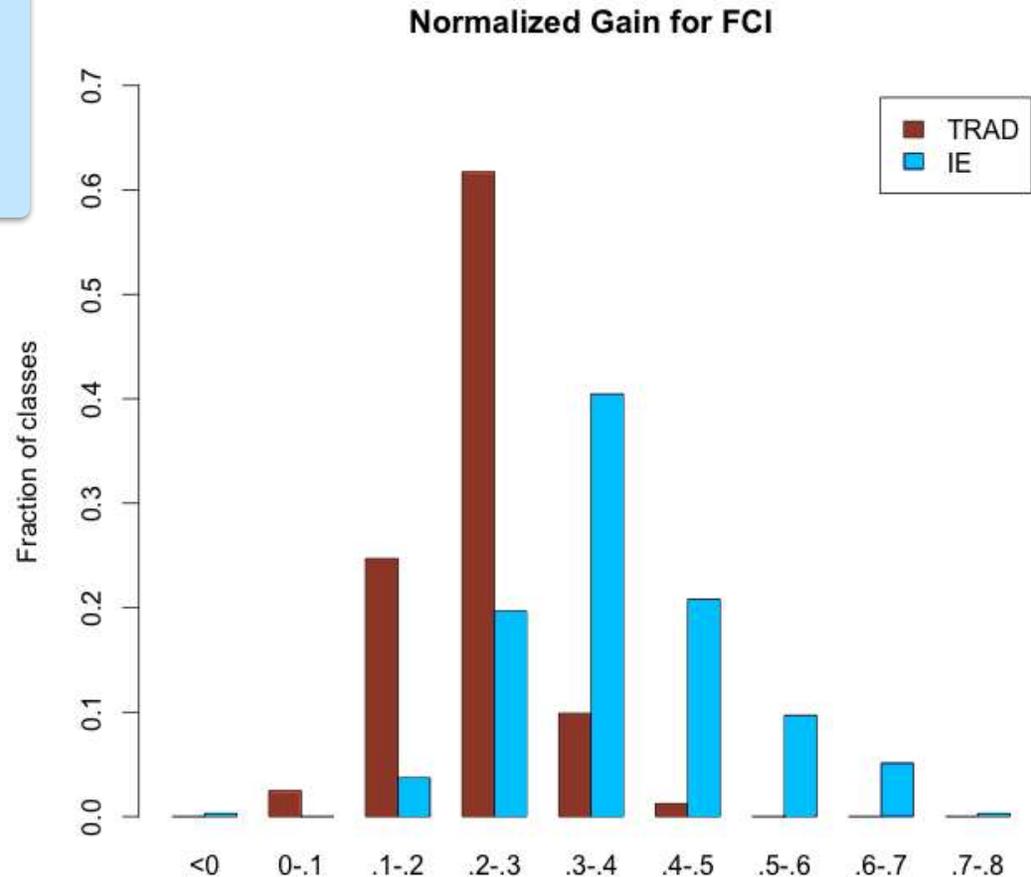
50,000 Students

Mechanics teaching

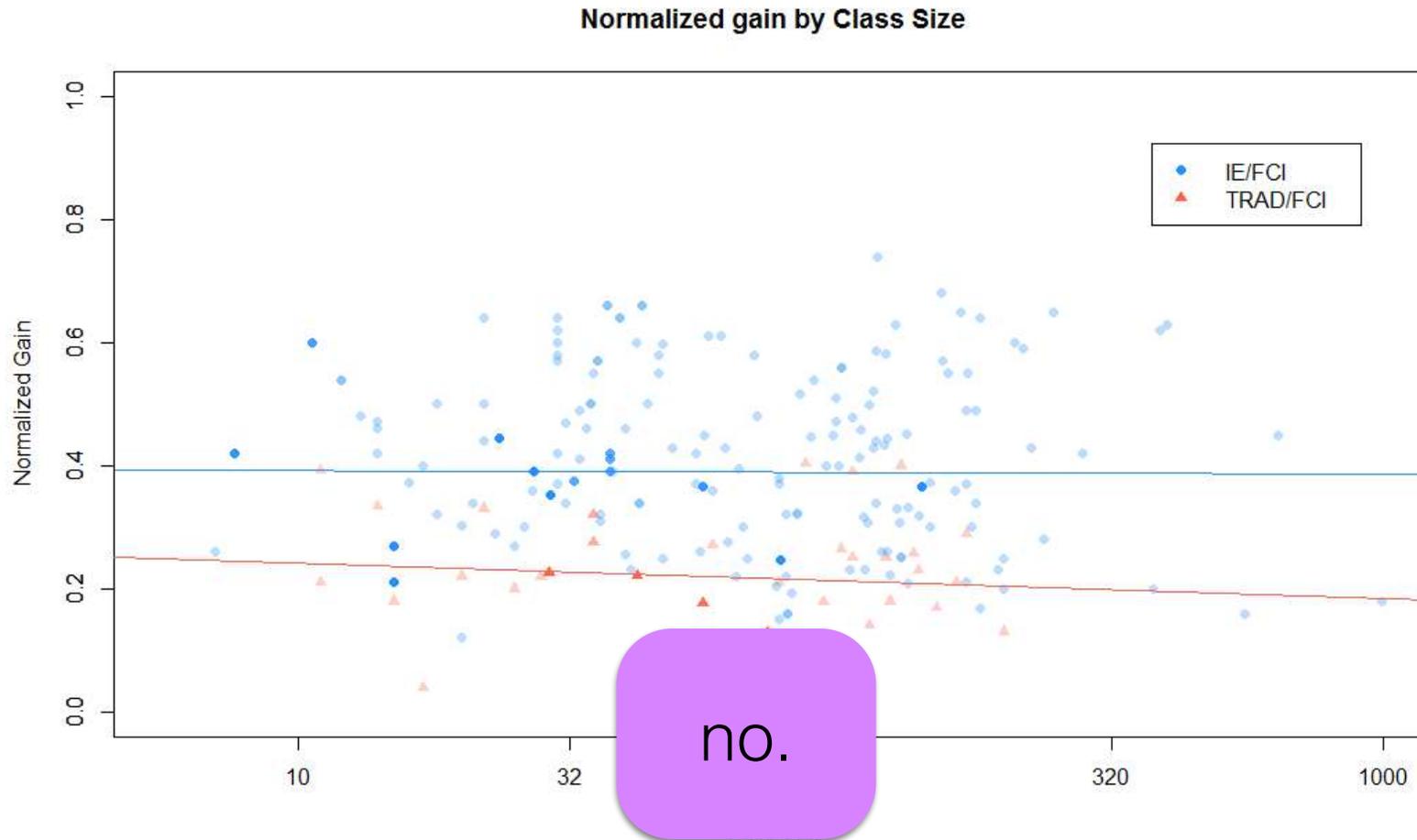
active learning
students do stuff
many different ways

Interactive
engagement
is better than
traditional lecture

chalk-and-talk
sage on the stage
cookbook labs



Does class size matter?



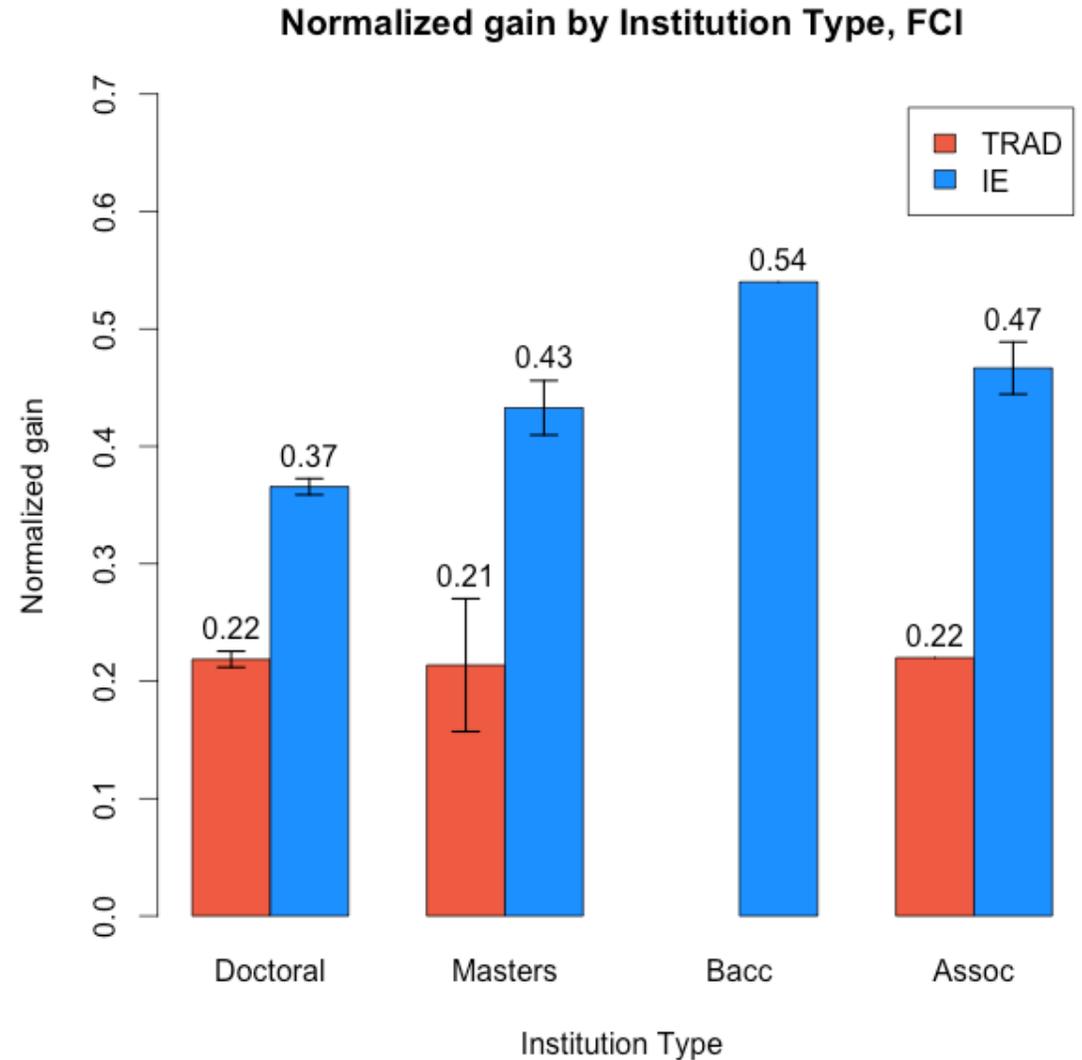
- Different sizes use different IE methods.
- Same trend for lecture and lab

Does institution type matter?

- Reduced Carnegie classification
- No Canadian schools

no.

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



Student beliefs about physics

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

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.

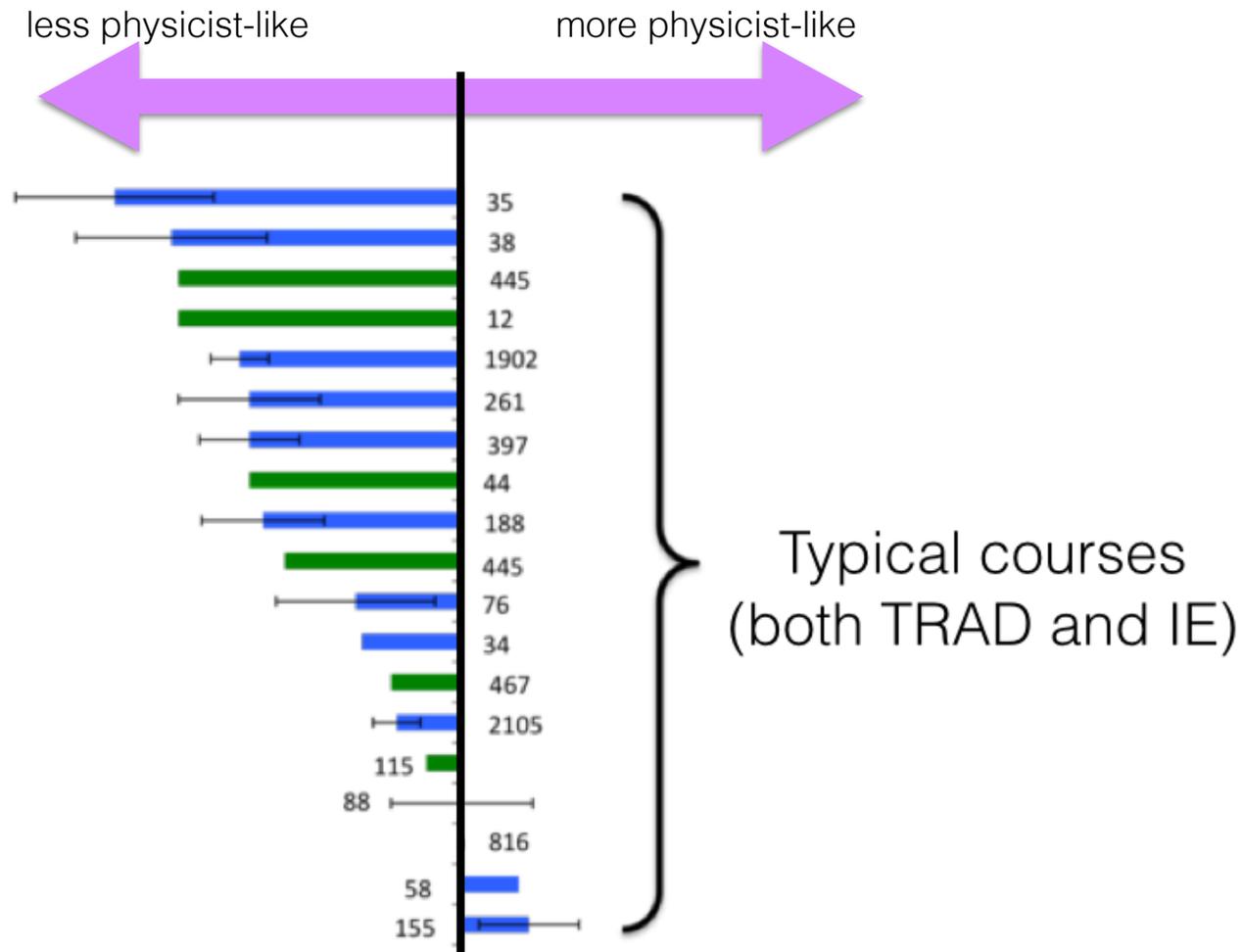
Strongly Disagree | 1 2 3 4 5 | Strongly Agree

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.



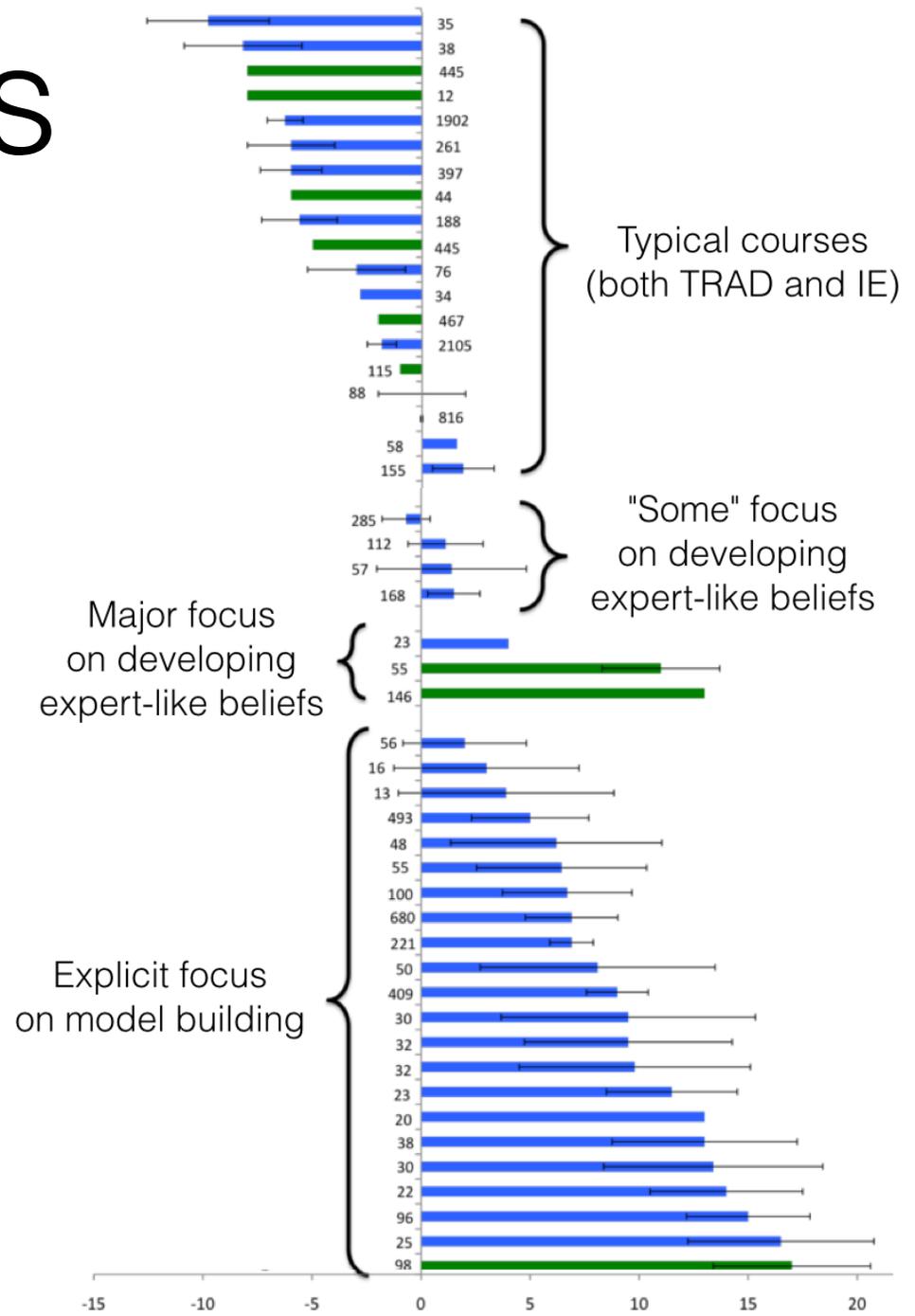
Madsen, A. M., McKagan, S. B., & Sayre, E. C. (2015). How Physics Instruction impacts students' beliefs about learning physics. *Physical Review Special Topics — Physics Education Research*.

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*.

Gender gaps in learning physics

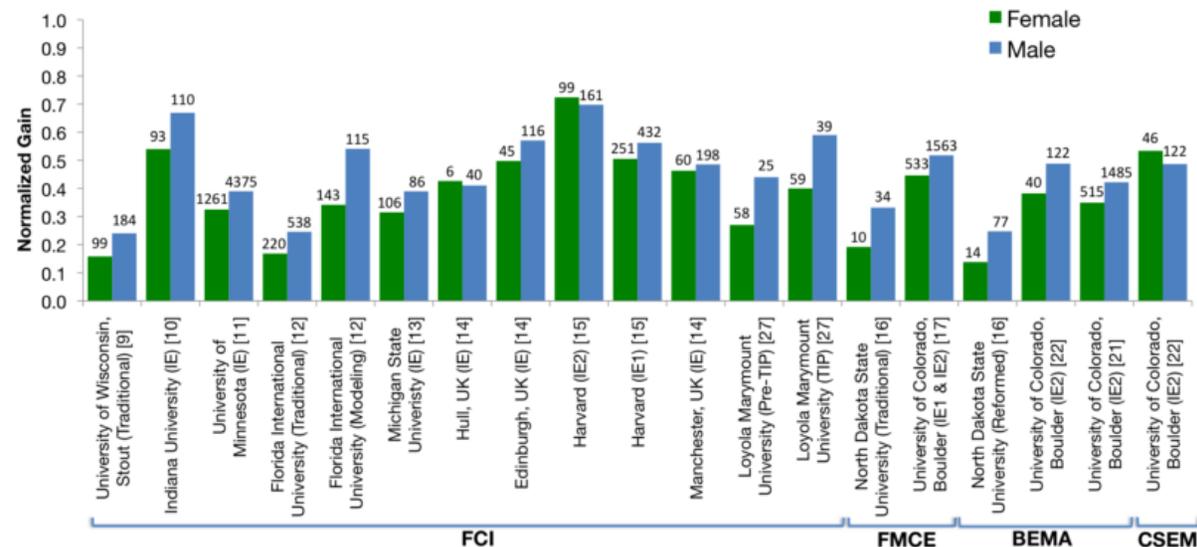
Men outperform women on RBAs

Mechanics: Men = .43; Women = .37

E&M: Men = .42; Women = .36

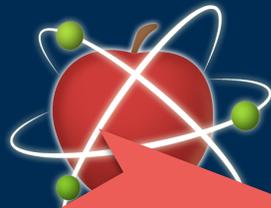
This is smaller than the Trad / IE gap.

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



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.

Questions so far?



PhysPort.org

go here now!

Supporting physics teaching
with research-based resources

Synthesis
research

Faculty-centered
online resources



Teaching Method
Resources

TM search

Faculty
Development

Periscope

Online
New Faculty
Workshop

Faculty-centered online resources

Assessment
Resources

Data Explorer

RBA search

Expert
Recommendations



Research and development process

Interview & survey
faculty and chairs

Synthesize
faculty needs

Build resources to
meet real users'
needs

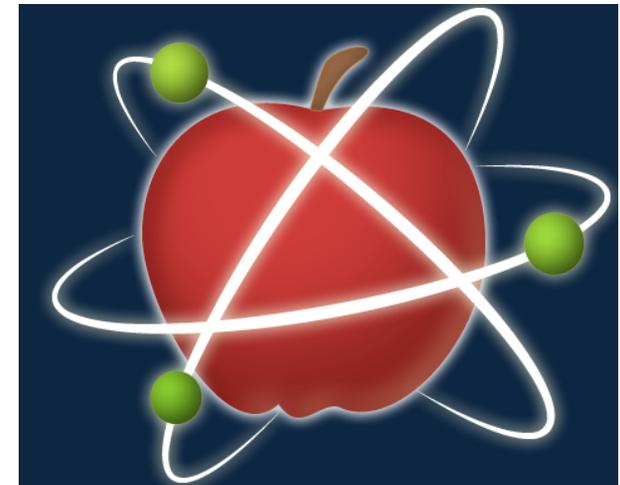
27 faculty
& chairs

50 LA video
project users

Faculty have
practical needs.

Faculty want
guidance.

Faculty consider
broader contexts.



PhysPort.org

Supporting physics teaching
with research-based resources

Start with the biggest needs of users.



PhysPort

Supporting physics teaching with research-based resources

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About Us | Contact Us



Home

Expert Recommendations

Teaching Methods

Assessments

Workshops

Welcome to PhysPort (formerly known as the PER User's Guide), the go-to place for physics faculty to find resources based on physics education research (PER) to support your teaching. [Learn more...](#)



Teaching

I want to...

- [find a new teaching method](#)
- [get implementation help](#)
- [learn more about research-based teaching](#)

Assessment

I want to...

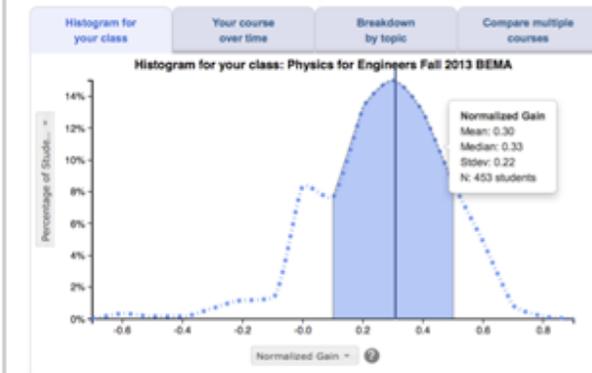
- [interpret assessment results](#)
- [assess the impact of reforms](#)
- [assess advanced physics content or skills](#)

Troubleshooting

I need help with...

- [covering enough material](#)
- [supporting group work](#)
- [arguments for skeptical colleagues](#)

NEW - PhysPort Data Explorer



Explore assessment data

Where can I find good questions to use with clickers or Peer Instruction?

by Sam McKagan, PhysPort director

September 26, 2016



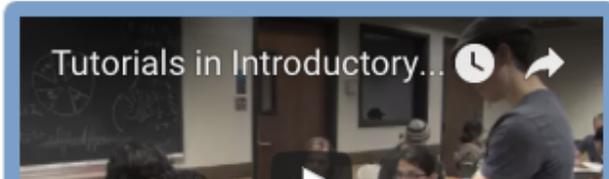
Many research-based teaching methods in physics, including Peer Instruction, CAE Think-Pair-Share, Technology Enhanced Formative Assessment, and teaching with clickers, involve having your students discuss and answer multiple-choice conceptual questions. A challenge of using these methods is finding and writing good questions. This recommendation helps you find and write questions for your

class.

[Peer Instruction](#) [CAE Think-Pair-Share](#) [clickers](#) [Technology-Enhanced Formative Assessment](#)

[Read more >](#)

Tutorials in Introductory...



Expert Recommendations

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

physport.org/recommendations

The screenshot shows the PhysPort website interface. At the top left is the PhysPort logo with the tagline "Supporting physics teaching with research-based resources". To the right are navigation links: "Admin | My Account | Logout" and "About Us | Contact Us", along with the AAPT logo. A horizontal navigation bar contains buttons for "Home", "Expert Recommendations" (which is highlighted in red), "Teaching Methods", "Assessments", and "Workshops".

Expert Recommendations

FEATURED

Addressing common concerns about concept inventories

by Adrian Madsen, Sam McKagan and Eleanor Sayre July 8, 2016



Concept inventories are useful for assessing the effectiveness of your teaching, but as you use them, concerns and questions often come up. Here we discuss some common concerns about using concept inventories and related research that addresses these concerns.

[Read more »](#)

[assessment](#), [concept inventories](#)

Where can I find good activities for small group discussions?

by Sam McKagan, PhysPort director

Where can I find good questions to use with clickers or Peer Instruction?

by Sam McKagan, PhysPort director

How can I get students to have productive discussions of clicker questions?

by Jenny Knight and Sarah Wise, University of Colorado - Boulder

Most Popular

- [Normalized gain: What is it and when and how should I use it?](#)
- [Arguments for skeptical colleagues](#)
- [How can I design an effective in-class student worksheet for PhET simulations?](#)

[View all »](#)

Tags

[active learning](#) [assessment](#) [best practices](#) [clickers](#) [concept inventories](#) [cooperative groups](#) [Peer Instruction](#) [PhET Interactive Simulations](#) [physics education](#) [research](#) [teaching](#)



Expert Recommendations

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

physport.org/recommendations

- Big Ideas
 - Ten results of physics education research that every physics instructor should know
 - Arguments for skeptical colleagues
 - What makes research-based teaching methods in physics work?
 - Recursos en Español / Research-based teaching resources in Spanish

Expert Recommendations

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

physport.org/recommendations

- Big Ideas
- Assessment issues
 - How do I get my students to take concept inventories seriously?
 - Guidelines for administering concept inventories online
 - How can I get my students' answers to concept inventories into electronic spreadsheets?
 - Effect size: What is it and when and how should I use it?
 - Normalized gain: What is it and when and how should I use it?

Expert Recommendations

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

physport.org/recommendations

- Big Ideas
- Assessment issues
- Teaching method help
 - Where can I learn more about research-based teaching in physics?
 - How can I get students to have productive discussions of clicker questions?
 - Which polling method should I use for Peer Instruction?
 - How do I facilitate Tutorials in Introductory Physics?

Expert Recommendations

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

physport.org/recommendations

- Big Ideas
- Assessment issues
- Teaching method help
- Teaching instructors
 - How can I train teaching assistants and/or learning assistants?
 - How do I facilitate a Periscope lesson for TA/LA training or faculty PD?
 - How can I teach a graduate class on the basics of physics education research?

Expert Recommendations

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

physport.org/recommendations

- Big Ideas
- Assessment issues
- Teaching method help
- Teaching instructors
- Broader issues
 - What racial, gender, and sexual orientation bias still exists in physics and what can I do about it?
 - How can I set up an effective mentoring program to support students in my department?

Have a suggestion?

Want to contribute?

esayre@ksu.edu

smckagan@aapt.org

Teaching Methods

Searchable, faculty-friendly guides to research-based teaching practices

physport.org/methods/

The screenshot shows the PhysPort website interface. At the top, there is a navigation bar with the PhysPort logo and the tagline 'Supporting physics teaching with research-based resources'. The navigation menu includes 'Home', 'Expert Recommendations', 'Teaching Methods' (highlighted), 'Assessments', and 'Workshops'. Below the navigation bar, the page title is 'Teaching Methods and Materials'. A search box prompts users to 'Tell us about your course to find methods relevant to you.' with dropdown menus for 'Any Subject', 'Any Level', and 'Any Setting', and a 'Submit' button. On the left side, there are filters for 'Student Skills Developed' and 'Instructor Effort Required'. The main content area displays '55 Research-Based Methods' sorted by 'Popularity'. Two methods are visible: 'Peer Instruction' and 'PhET Interactive Simulations'. Each method entry includes a subject icon, a level bar, and a setting icon.

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

Assessment Resources

physport.org/assessments

- Search for RBAs
- Get administration data
- See sample questions
- See typical results
- Download RBAs
- Download usage guide

project info



PhysPort
Supporting physics teaching with research-based resources

Admin | My Account | Logout
About Us | Contact Us

Home | Expert Recommendations | Teaching Methods | **Assessments** | Workshops

Browse Assessments

Tell us about your course to find assessments relevant to you.

Any Subject | Any Level | Submit

82 Research-Based Assessments

Sort by: Research validator

- Force Concept Inventory (FCI)**
Mechanics Content knowledge (forces, kinematics)
Levels: Intro college, High school
Formats: Pre/post, Multiple-choice
30 min
- Colorado Learning Attitudes about Science Survey (CLASS)**
Beliefs / Attitudes (epistemological beliefs)
Levels: Upper-level, Intermediate, Intro college, High school
Formats: Pre/post, Multiple-choice, Agree/disagree
8-10 min
- Brief Electricity and Magnetism Assessment (BEMA)**
Electricity / Magnetism Content knowledge (circuits, electrostatics, magnetic fields and forces)
Levels: Upper-level, Intro college
Formats: Pre/post, Multiple-choice
45 min
- Force and Motion Conceptual Evaluation (FMCE)**
Mechanics Content knowledge (kinematics, forces, energy, graphing)
35 min

Assessment Focus
Any

- Content knowledge
- Problem-solving
- Scientific reasoning
- Lab skills
- Beliefs / Attitudes
- Interactive teaching

Format
Any

- Pre/post ?
- Multiple-choice
- Multiple-response ?
- Agree/disagree ?
- Short answer
- Rubric ?
- Observation protocol ?

Research Validation ?

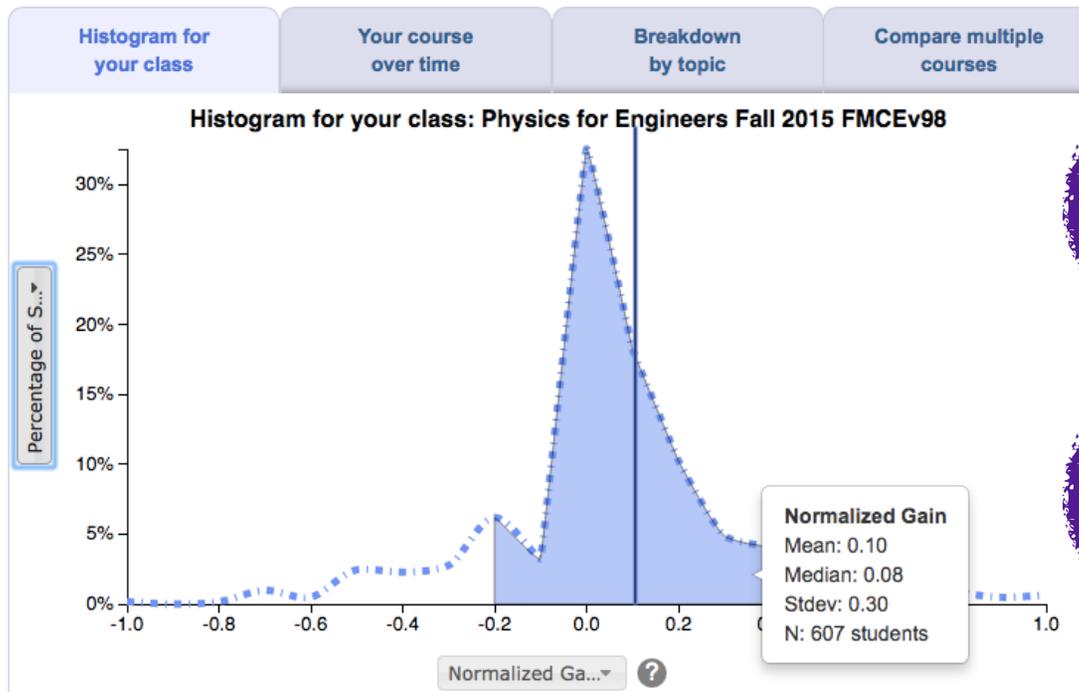
- Gold star validation
- Silver validation
- Bronze validation
- Research-based

Translations

Data Explorer

Visualize and compare your students' performance from 50+ research-based assessment instruments.

physport.org/DataExplorer



Upload your data

Explore your data

Download a report



Data Explorer



Secure

We use the same security measures used by banks and financial institutions

so you can have the utmost confidence that your data is safe.

- Your identity is protected
- Your students' identities are protected
- We use one-way, cryptographically-secure transformations
- We report on aggregate data



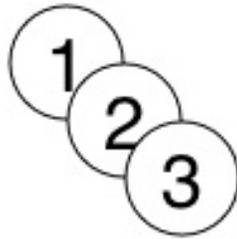
Data Explorer



Secure

We use the same security measures used by banks and financial institutions

so you can have the utmost confidence that your data is safe.



Easy.

Our guided process makes it easy to upload your data, and our visualization

engine is tailored to assessments, making charting a snap.

- We match pre- and post-data for you
- You can upload the files you already have*: no need to use a template

* .csv, xls, or .xlsx; one assessment per file; one row per student



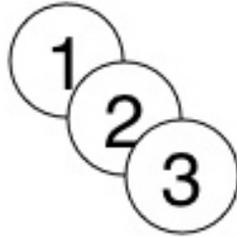
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Powerful

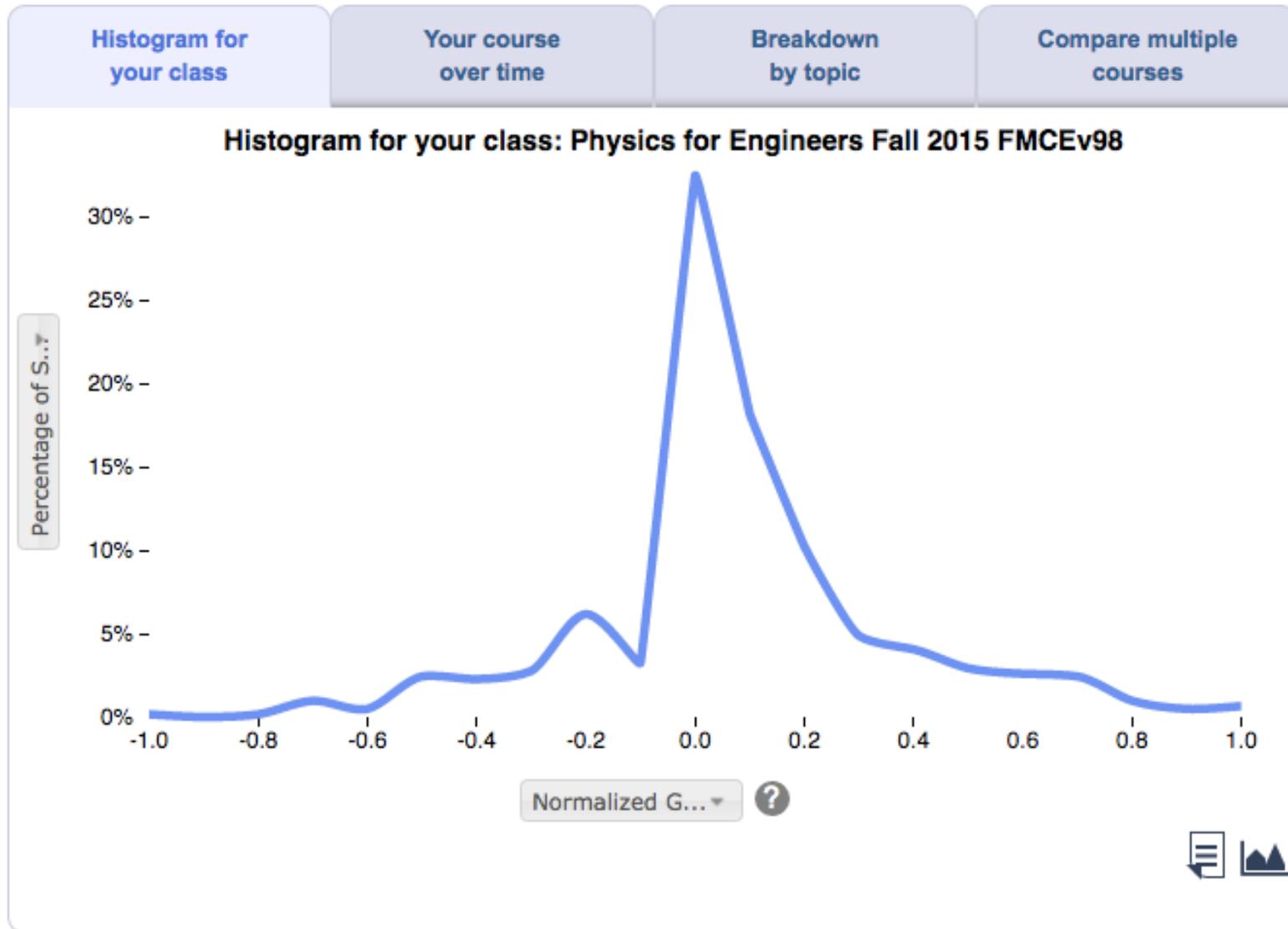
With one click, you get a comprehensive analysis of your results, allowing you

to compare your data with classes and teachers in similar institutions nationwide.

- Explore responses on by questions or clusters
- Track your classes over time
- Split data by demographics
- Rigorous statistics done for you in the background



physport.org/DataExplorer



physport.org/DataExplorer

Histogram for
your class

Your course
over time

Breakdown
by topic

Compare multiple
courses

Summary

Average
Gain ?
0.10
 ± 0.01

Your students' average normalized gain of 0.10 ± 0.01 is near the bottom of the range for traditional lecture classes . See [typical results](#).

Effect Size ?
0.61

The effect size of the change between pre and post for your class is **0.61**. This is a moderate effect size

Average
Score ?
Pre 18%
 $\pm 1\%$
Post 30%
 $\pm 1\%$

Your students' average score increased from $18\% \pm 1\%$ on the pre-test to $30\% \pm 1\%$ on the post-test. See [typical results](#).

N (matched)
607

You have 607 "matched" students (who took both the pre- and post-test) in your class. All calculations are based on matched students.

Recommendations

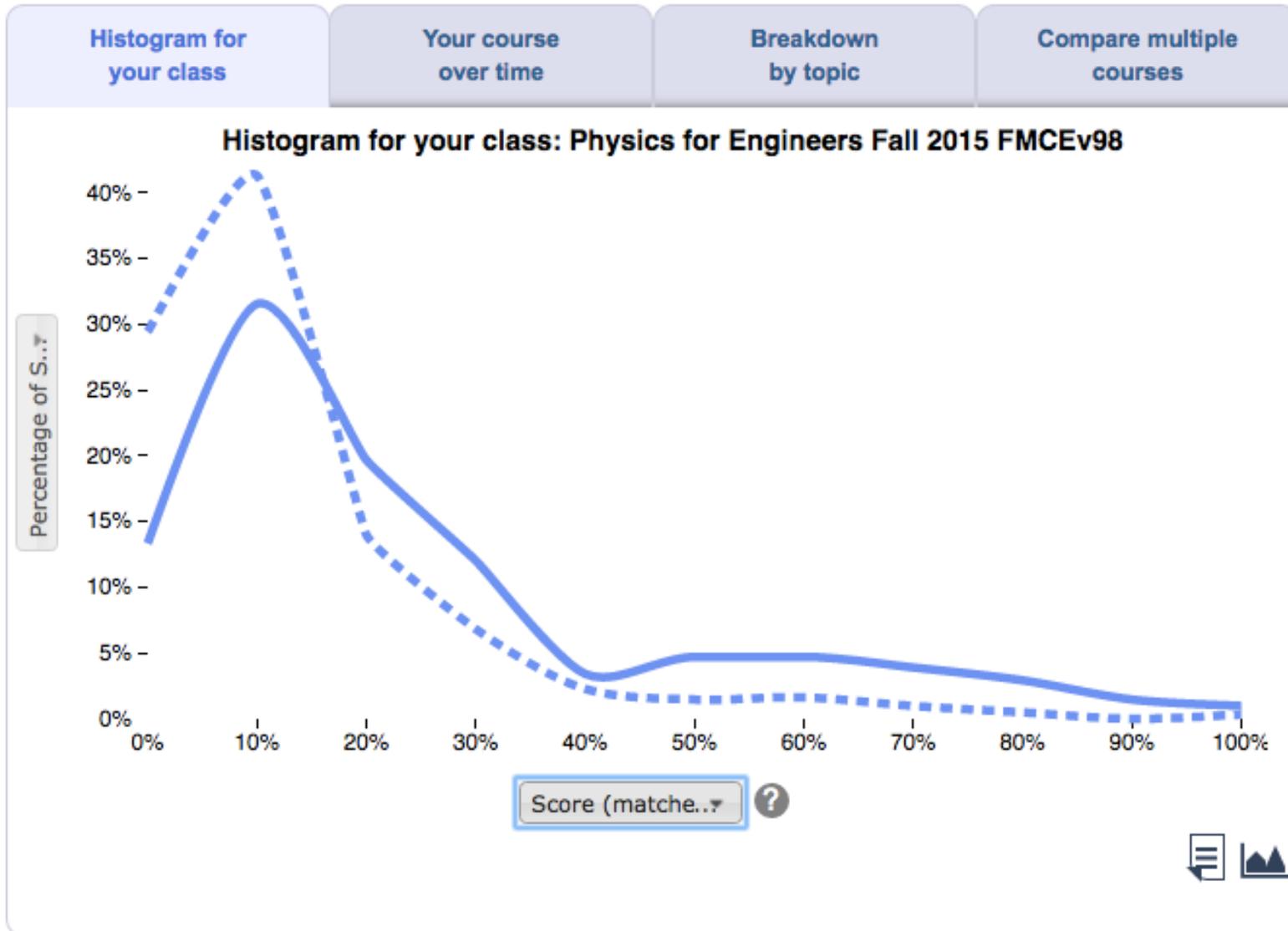
Courses that are taught using interactive engagement techniques tend to have higher normalized gains than those using traditional lecture. The key to these methods is getting students actively engaged in constructing their own understanding and not just passively listening.

This can be accomplished in many ways. Popular methods that you could try include: [Peer Instruction](#), [PhET Interactive Simulations](#), [Interactive Lecture Demonstrations](#), and [Just In Time Teaching](#).

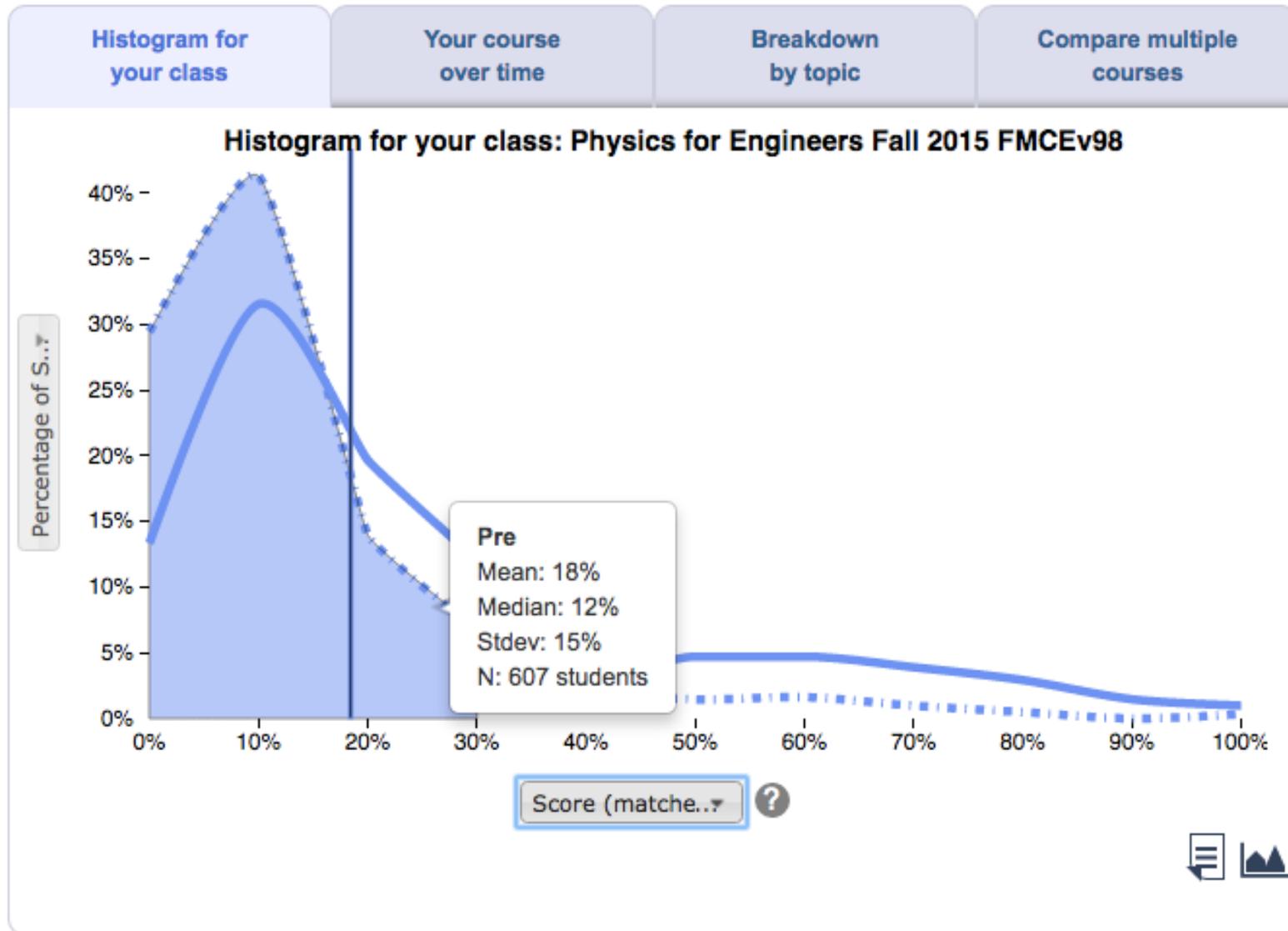
As we collect more data on how teaching practices correlate with learning gains, we will eventually provide more customized recommendations.



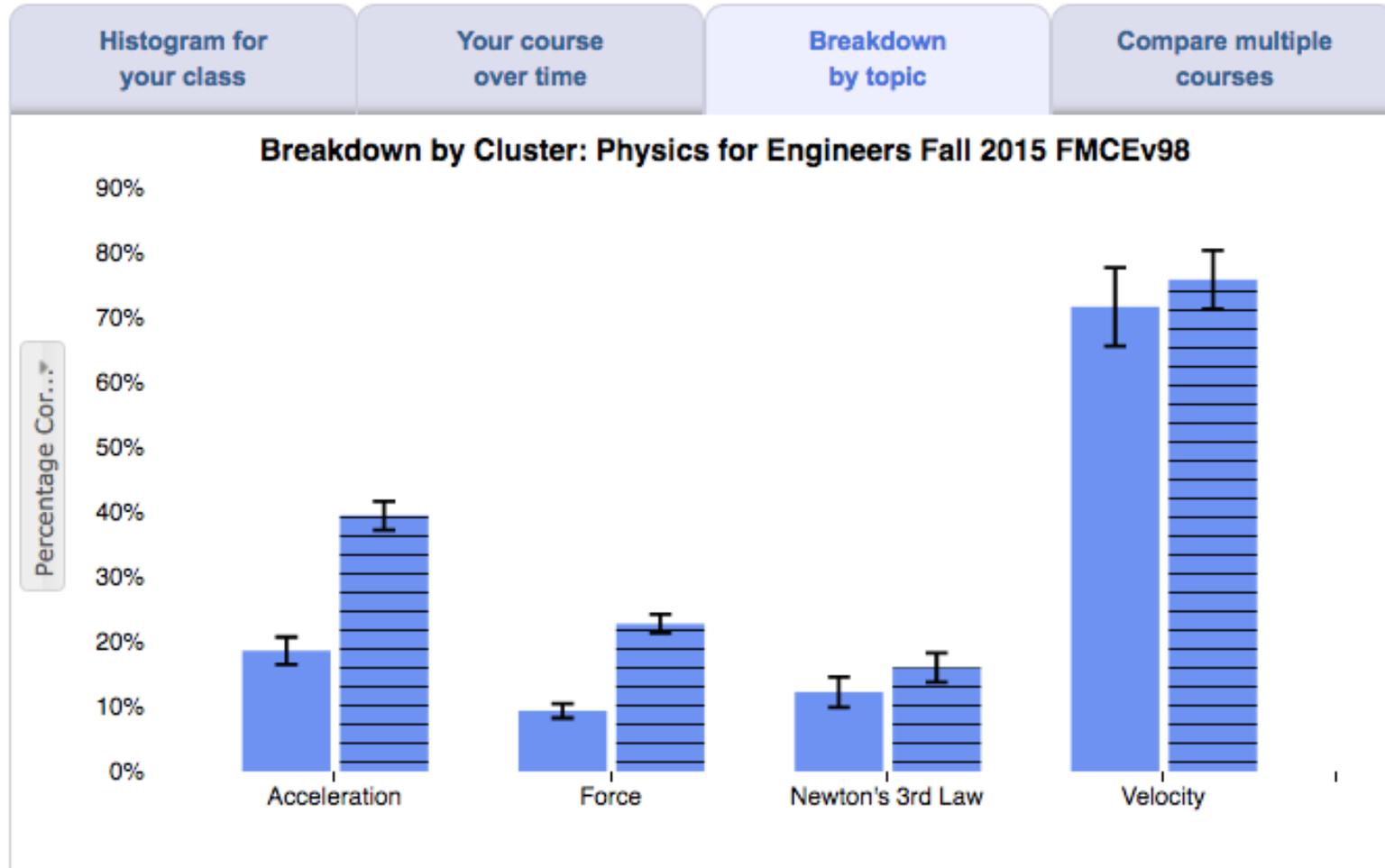
physport.org/DataExplorer



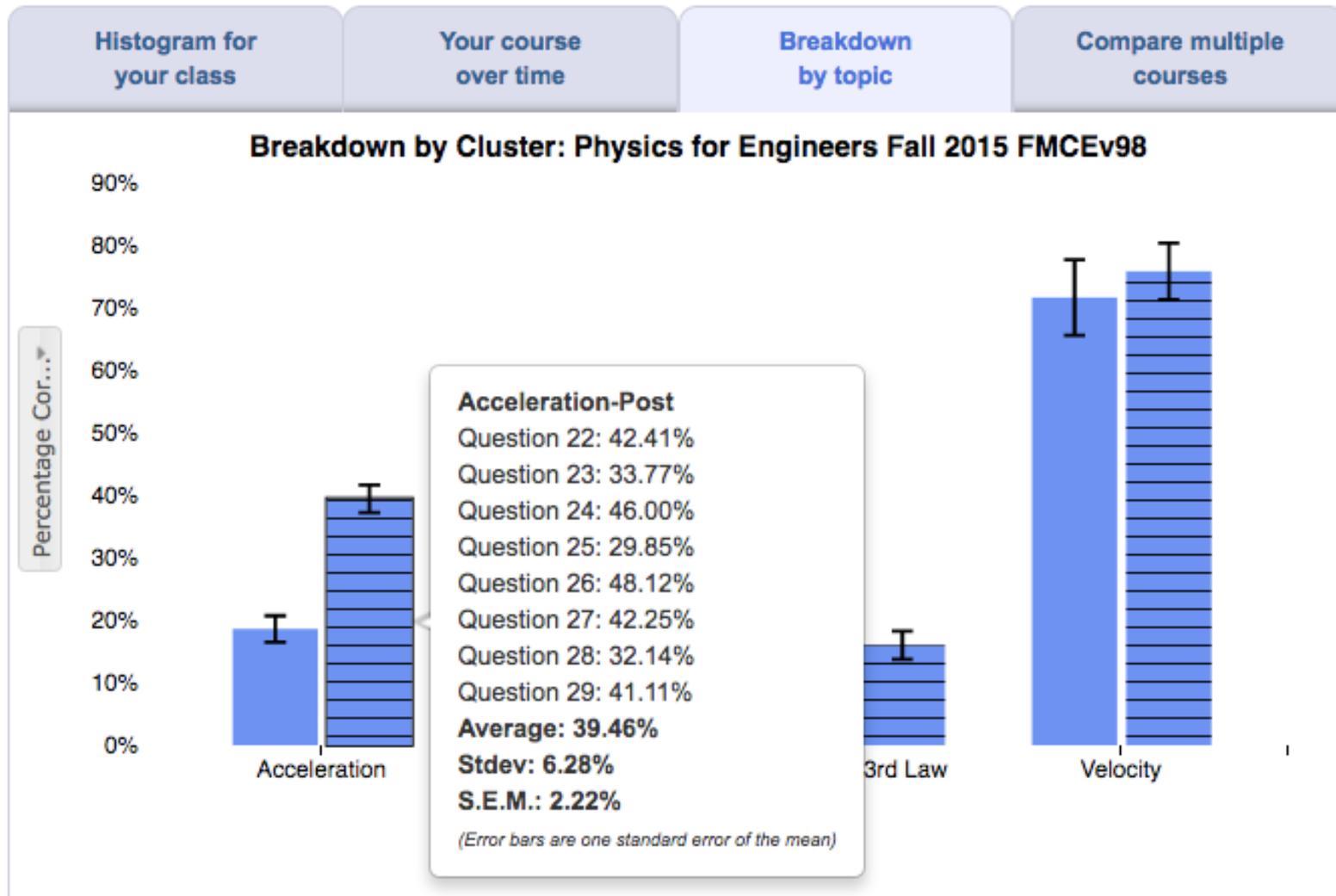
physport.org/DataExplorer



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physport.org/DataExplorer



physport.org/DataExplorer

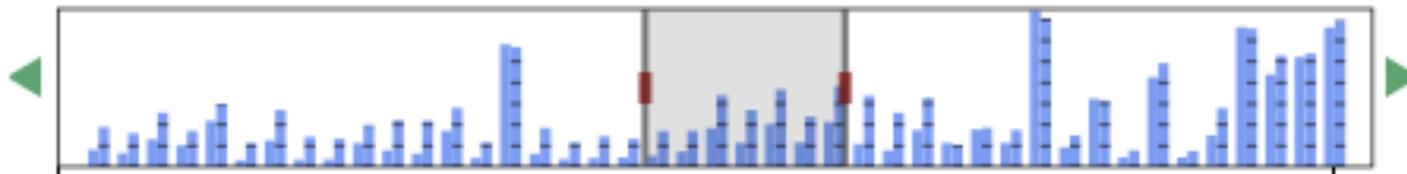
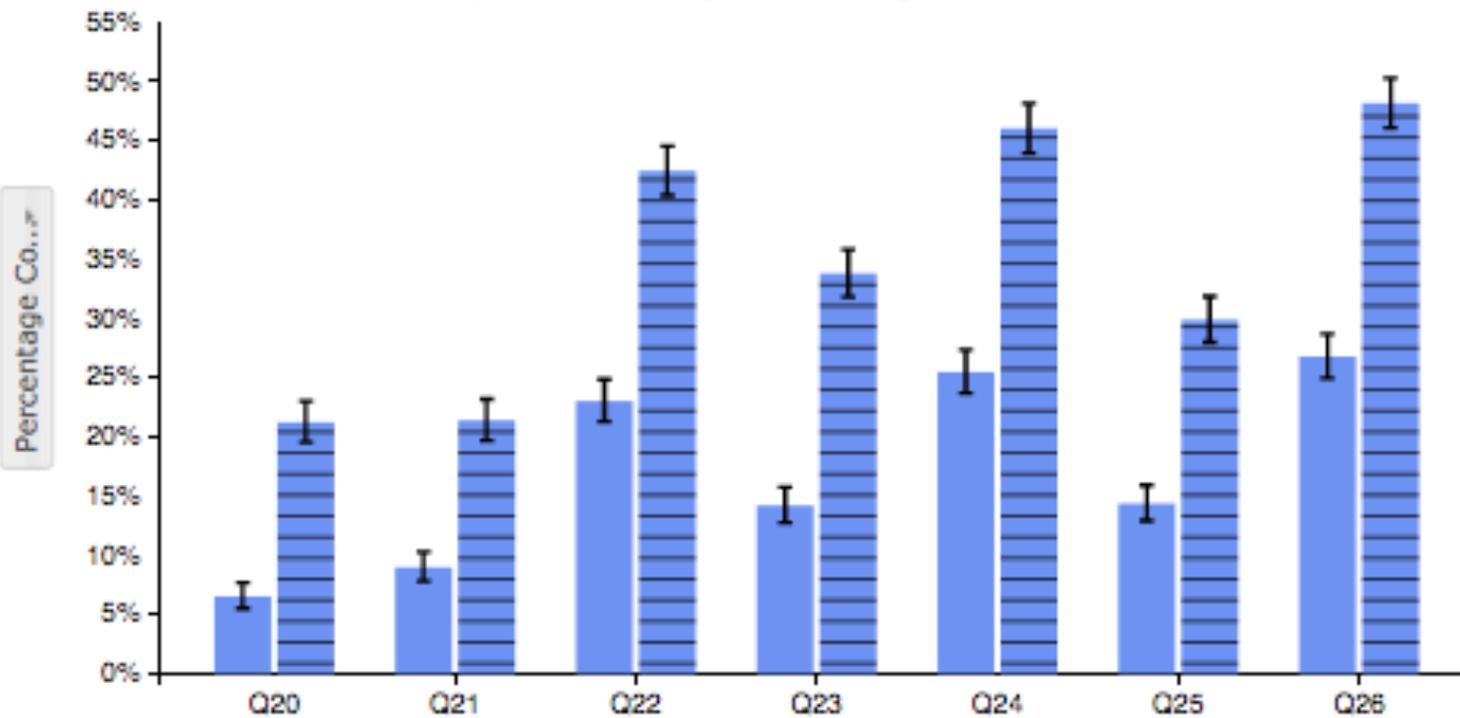
Histogram for
your class

Your course
over time

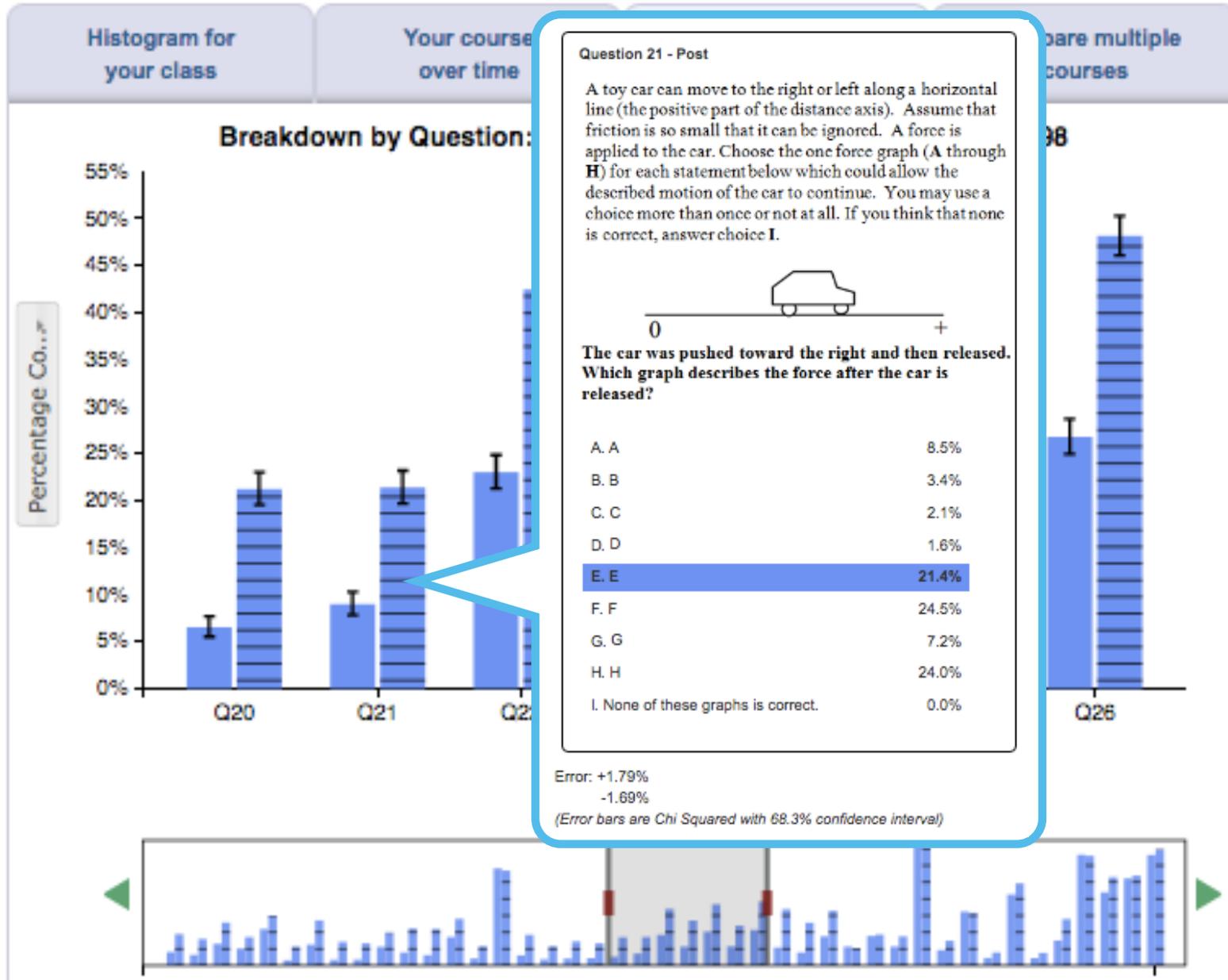
Breakdown
by topic

Compare multiple
courses

Breakdown by Question: Physics for Engineers Fall 2015 FMCEv98



physport.org/DataExplorer



Data Explorer

Visualize and compare your students' performance from 60+ research-based assessment instruments.

physport.org/DataExplorer

- Compare multiple courses
- Track your courses over time
- Group and split by gender, major, section, instructor, etc
- Easy to upload
- Download reports for your tenure file
- Coming soon:
 - Compare to national averages
 - Add custom assessments

Available now!

FCI, FMCE
CSEM, BEMA
CLASS, MPEX

Available soon!

60+
research-based
assessments



Online workshops

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

physport.org/workshops



What is Periscope?

Find the Periscope video collection at <http://PhysPort.org/periscope>

Periscope: Looking into Learning

What is Periscope?

A collection of lessons for faculty and LAs/TAs to:

- watch and discuss videos of best-practices physics classrooms
- apply lessons learned to actual teaching situations
- practice interpreting student behavior
- become more effective teachers

[View Collection](#)



New Faculty Workshop - Introduction

Techniques for all size classes

Learner-Centered Instruction in Physics and Astronomy
Dr. Edward Prether, University of Arizona

PhysPort
Supporting physics teaching with research-based resources
www.PhysPort.org

Virtual New Faculty Workshop

What is the Virtual New Faculty Workshop?

Videos of presentations from the live Workshop for New Faculty in Physics and Astronomy feature:

- leaders in physics education research and curriculum development
- teaching techniques proven to work in many environments
- cutting-edge developments in physics/astronomy curriculum and pedagogy

[View Collection](#)



Periscope

physport.org/periscope

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

How can I best facilitate a student discussion?

Part of the Periscope collection 

What is Periscope?

[View Facilitators Guide](#) ▼

 1 Watch classroom video

 2 Discuss in small groups

 3 Discuss with whole group

Some physics classes intersperse collaborative work in small groups with whole-class discussions. The purpose of these whole-class discussions is for students to share their small group's work, appreciate other groups' work, and collaborate to increase everyone's understanding. How should instructors facilitate student discussions?

[Modeling Instruction](#), [mechanics](#), [forces](#), [friction](#), [Florida International University](#)


Download
Lesson
[What's in
this?](#)

Self Study

You can also use Periscope lessons for self-study by watching the video episode and reflecting on the sample discussion prompts. In this case, we recommend printing out the handout so that you can easily refer to it while watching the episode, or opening both the episode and the handout on a large screen.



This episode shows a group of about twenty students in a Modeling Instruction "board meeting," in which students who just presented their work share a question that came up for them in their analysis. Sample discussion prompts are about how the instructor facilitates the student discussion.

Periscope

physport.org/periscope

Videos of students working with handouts for training TAs and faculty

How can I best facilitate a student discussion?

What is Periscope?

- 1 Watch classroom video
- 2 Discuss in small groups

Some physics classes intersperse collaborative work in small groups with whole-class discussions. The purpose of these whole-class discussions is for students to share their small group's work, appreciate other groups' work, and collaborate to increase everyone's understanding. How should instructors facilitate student discussions?

[Modeling Instruction](#), [mechanics](#), [forces](#), [friction](#), [Florida International University](#)

Periscope
Looking into learning
The purpose of this Periscope is to help you understand how to facilitate student discussions.

Episode 502: "Moving box"

FIU

0:00 / 2:39

Open handout in new window

This episode shows a group of about twenty students in a Modeling Instruction "board meeting," in which students who just presented their work share a question that came up for them in their analysis. Sample discussion prompts are about how the instructor facilitates the student discussion.

HANDOUT

How can I best facilitate a student discussion?

Introduction

Some physics classes intersperse collaborative work in small groups with whole-class discussions. The purpose of these whole-class discussions is for students to share their small group's work, appreciate other groups' work, and collaborate to increase everyone's understanding. How should instructors facilitate student discussions?

This episode shows a group of about twenty students in a Modeling Instruction "board meeting," in which students who just presented their work share a question that came up for them in their analysis. Sample discussion prompts are about how the instructor facilitates the student discussion.



Episode: "Moving box"

Task for students

(from University Modeling Instruction)

A block is placed against the vertical front of a cart as shown in the figure. What acceleration must the cart have so that block A does not fall? The coefficient of static friction between the block and the cart is μ_s .



Sample discussion prompts

1. What did you observe in this episode? Talk to your partners about what you saw.
2. The instructor (Leon) has been quiet for a while when Arden poses her question. What does he do while he is not talking? What message do you think his behavior sends?

Periscope

physport.org/periscope

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

How can I best facilitate a student discussion?

Part of the Periscope collection

What is Periscope?

[View Facilitators Guide](#)



1 Watch classroom video



2 Discuss in small groups



3 Discuss with whole group

Some physics classes intersperse collaborative work in small groups with whole-class discussions. The purpose of these whole-class discussions is for students to share their small group's work, appreciate other groups' work, and collaborate to increase everyone's understanding. How should instructors facilitate student discussions?

[Modeling Instruction](#), [mechanics](#), [forces](#), [friction](#), [Florida International University](#)


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Lesson
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this?](#)

Self Study

You can also use Periscope lessons for self-study by watching the video episode and reflecting on the sample discussion prompts. In this case, we recommend printing out the handout so that you can easily refer to it while watching the episode, or opening both the episode and the handout on a large screen.



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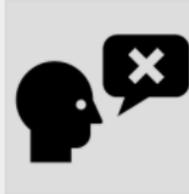
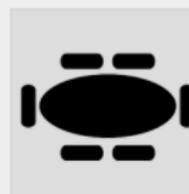
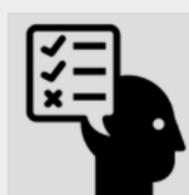


Periscope

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I want to lead a weekly TA/LA seminar	I want to lead a half-day TA/LA workshop	I want to prepare colleagues to use best practices
I want to prepare colleagues to design learning environments	I want to prepare colleagues to train TAs/LAs	I want to teach TAs/LAs what ideas students have about a particular physics topic
I want to teach TAs/LAs about a particular instructional method	I want to support underrepresented groups	I want to improve my own teaching
I want to see all lessons in the Periscope collection Download All		

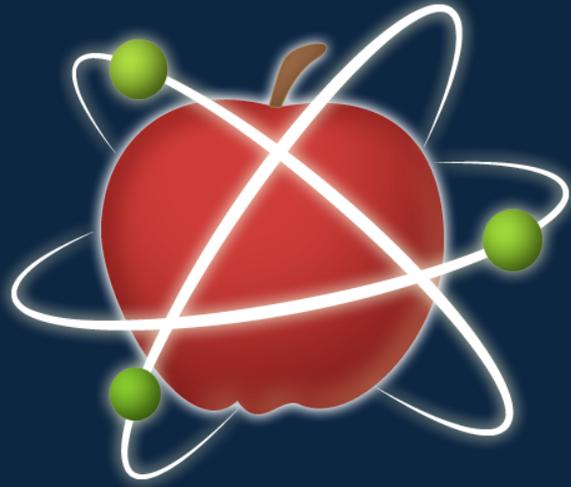
Use these Periscope lessons to reflect on classroom practices and interactions in order to better listen to and interpret students in your own classrooms. X

 Best Practices for Teaching (2 lessons)	 When It's Right to Be Wrong (2 lessons)	 Collaborative learning (8 lessons)	 Physics Feng Shui (1 lesson)
 Dissatisfied Students (5 lessons)	 Interactions in Diverse Classrooms (1 lesson)	 Tasks to Stimulate Deep Thinking (1 lesson)	

Available now!

54 lessons

Facilitators'
Guide



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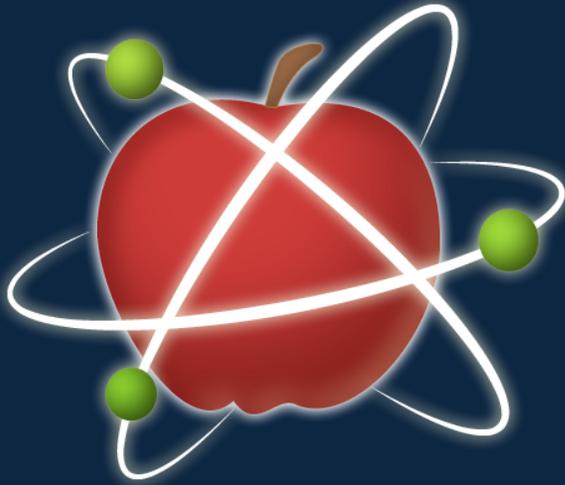
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