Assessment Tools & the PhysPort Data Explorer

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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)
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Lyle Barbato (development lead)
Matt Riggsbee (visual design)

Kansas State University

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Bill Hsu (development lead)
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Cognition Technology

Sandy Martinuk
Alex Bell
(User Experience)

Periscope Specialists

Rachel Scherr
Stephanie Chasteen
Good teaching and assessment are important.

- How do you know if students are learning?
- Assessment is a gateway drug
- How to teach better?
- How to help students learn more?
PER can help.

Faculty professional development

New Faculty Workshop

Periscope

Research-Based Assessments

Embedded in curricula

Assessment instruments

Research-based teaching methods

Published curricula

Curricular elements
PER resources are scattered.

- Developer websites
- Ask a colleague
- Attend a workshop

- 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.

Finding information and advice

Supporting physics teaching with research-based resources

Changing department practices

Synthesis research

Faculty-centered online resources
Synthesis research

Interpret the results of diverse PER studies

100,000 students

Weighted combination of data from published studies

More robust than single study

Vulnerable to publishing bias


What are Research-based Assessments?

Force Concept Inventory (FCI)
Force & Motion Conceptual Evaluation (FMCE)
and 60+ 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

- Interactive Engagement (IE): 0.39 ± 0.05 vs. Traditional (TRAD) 0.19 ± 0.05

- 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 |

Student Beliefs

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

"Ordinary" IE is not enough.

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

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.

Questions so far?
PhysPort

Supporting physics teaching with research-based resources

- Synthesis research
- Faculty-centered online resources
Faculty-centered online resources

- Teaching Method Resources
  - TM search
- Faculty Development
- Online New Faculty Workshop
- Assessment Resources
  - Data Explorer
- RBA search
- Expert Recommendations
- Periscope
Research and development process

Interview & survey faculty and chairs → Synthesize faculty needs → Build resources to meet real users' needs

27 faculty & chairs

Faculty have practical needs.

50 LA video project users

Faculty want guidance.

Faculty consider broader contexts.

PhysPort.org
Supporting physics teaching with research-based resources
Start with the biggest needs of users.
Expert Recommendations

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

physport.org/recommendations
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

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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?

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Teaching Methods

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

physport.org/guides/browse.cfm

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

big redesign coming soon
Assessment Resources

physport.org/assessments

- Search for RBAs
- Get administration details
- See sample questions
- See typical results
- Download RBAs
- Download usage guides
Verified educators can download.

Students cannot.

**Example Question 1**

A book is at rest on a table top. Which of the following force(s) is(are) acting on the book?

1. A downward force due to gravity
2. The upward force by the table
3. A net downward force due to air pressure
4. A net upward force due to air pressure

(A) 1 only
(B) 1 and 2
(C) 1, 2, and 3
(D) 1, 2, and 4
(E) none of these, since the book is at rest there are no forces acting on it.
**Force Concept Inventory (FCI)**

developed by David Hestenes, Malcolm Wells, and Gregg Swackhamer

http://modelinginstruction.org/researchers/evaluation-instruments/

**Format**
- Multiple-choice, Pre/post

**Duration**
- 30 minutes

**Focus**
- Mechanics Content Knowledge (Kinematics, Forces)

**Level**
- Introductory

**Typical Results**

![Normalized Gain for FCI](image)

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**Related Expert Recommendations**

- **Best practices for administering concept inventories**
- **Should I use the FCI or the FMCE?**
- **Why use research-based assessment?**

**Related Assessments**

- **Mechanics Baseline Test (MBT)**
- **Force and Motion Conceptual Evaluation (FMCE)**

**Related Teaching Methods**

**Modeling Instruction**

Instruction organized around active student construction of conceptual and mathematical models in an interactive learning community
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#### Typical Results

![Normalized Gain for FCI](image)

**FCI Implementation and Troubleshooting Guide**

This guide covers all the information teachers would need to implement this assessment in their course. It also includes troubleshooting information and links to additional resources.

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**Typical Results**

**Examples**  **Resources**  **Research**  **Translations**  **Variations**

**Research Validation**

**Gold Star Validation**
This is the highest level of research validation. This indicates that the assessment instrument has been thoroughly validated and researched.

**Research Validation Summary**

**Based on Research Into:**
- Student thinking

**Studied Using:**
- Student interviews
- Expert review

**Research Conducted**
- At multiple institutions
- By multiple research groups

**Related Expert Recommendations**

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  Instruction organized around active student construction of conceptual and mathematical models in an interactive learning community
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

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

- 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
Data Explorer

- Explore responses on by questions or clusters
- Track your classes over time
- Split data by demographics
- Rigorous statistics done for you in the background
Histogram for your class: Physics for Engineers Fall 2015 FMCEv98

30% –
25% –
20% –
15% –
10% –
5% –
0% –
-1.0 – -0.8 – -0.6 – -0.4 – -0.2 – 0.0 – 0.2 – 0.4 – 0.6 – 0.8 – 1.0 –

Normalized G…?
### Summary

- **Average Gain**: \(0.10 \pm 0.01\) is near the bottom of the range for traditional lecture classes. See [typical results](#).

- **Effect Size**: \(0.61\)

- **Average Score**
  - **Pre**: \(18\% \pm 1\%\)
  - **Post**: \(30\% \pm 1\%\)

- **N (matched)**: 607

### 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
Breakdown by Cluster: Physics for Engineers Fall 2015 FMCEv98

- Acceleration
- Force
- Newton's 3rd Law
- Velocity
Breakdown by Cluster: Physics for Engineers Fall 2015 FMCEv98

- **Acceleration**
  - Question 22: 42.41%
  - Question 23: 33.77%
  - Question 24: 46.00%
  - Question 25: 29.85%
  - Question 26: 48.12%
  - Question 27: 42.25%
  - Question 28: 32.14%
  - Question 29: 41.11%
  - **Average:** 39.46%
  - **Stdev:** 6.28%
  - **S.E.M.:** 2.22%

- **Conservation of Momentum**

- **Velocity**

*Error bars are one standard error of the mean*
A toy car can move to the right or left along a horizontal line (the positive part of the distance axis). Assume that friction is so small that it can be ignored. A force is applied to the car. Choose the one force graph (A through H) for each statement below which could allow the described motion of the car to continue. You may use a choice more than once or not at all. If you think that none is correct, answer choice I.

The car was pushed toward the right and then released. Which graph describes the force after the car is released?

A. A 8.5%
B. B 3.4%
C. C 2.1%
D. D 1.6%
E. E 21.4%
F. F 24.5%
G. G 7.2%
H. H 24.0%
I. None of these graphs is correct. 0.0%

Error: +1.79% -1.69%
(Error bars are Chi Squared with 68.3% confidence interval)
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
• Coming soon:
  • Download PDF assessment report
  • Compare to national averages

Available now!

FCI, FMCE
CSEM, BEMA
CLASS, MPEX

Available F’16!

50+ research-based assessments
Online workshops

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

physport.org/workshops
Periscope

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

How can I facilitate students working well in groups? I

What is Periscope?
1 Watch classroom video
2 Discuss in small groups
3 Discuss with whole group

Group work is an important part of many physics classes. As instructors we may be hoping that during group work students will validate each other’s correct ideas, refute each other’s incorrect ideas, raise important questions, and generally provide each other with a safe and productive mini-environment for learning. However, it’s hard to know whether groups are really accomplishing these things, especially when we’re not there. How can we facilitate students working well in groups?

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 students in a tutorial discussing possible microscopic mechanisms by which objects become charged. Sample discussion prompts are about what they do in this discussion, what supports them in having a good discussion, and what instructors can do to promote productive group work.

physport.org/periscope
Periscope

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

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Introduction

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Task for students

Stick two pieces of tape to a smooth surface, one on top of the other, each with a bit folded over to make it easier to grab. Label the bottom tape "B" and the top tape "T." Peel them off the surface together, then uncharge the pair together by rubbing them on your lip. Finally, pull the two tapes apart.

A. Which tape is charged: the T tape, the B tape, neither, or both? Give evidence.

B. Draw a T tape and a B tape that are separated halfway. Use "+" and "-" symbols to indicate the parts of the tapes that are charged and the type of charge.
I want to....

• lead a weekly TA/LA seminar
• lead a half-day TA/LA workshop
• teach TAs/LAs what ideas students have about a particular physics topic
• teach TAs/LAs about a particular instructional method
Periscope

What is Periscope?
1. Watch classroom video
2. Discuss in small groups
3. Discuss with whole group

What do you want to do?

• I want to....
• I want to....
  • prepare colleagues to use best practices
  • prepare colleagues to design learning environments
  • prepare colleagues to train TAs/LAs
Periscope

What do you want to do?

• I want to....
• I want to....
• I want to....
  • support underrepresented groups
  • improve my own teaching

Guided suites of lessons by topic

physport.org/periscope
Resources

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

Be a verified educator!
Download assessments
Take online workshops

Be a Data Explorer beta-tester!
if you have assessment data for:
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Email us to learn more:
smckagan@aapt.org
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