Research-based resources on PhysPort

Eleanor C Sayre,
Sam McKagan,
Adrian M Madsen
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
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.

Supporting physics teaching with research-based resources

Finding information and advice

Changing teaching practices

Faculty-centered online resources

Synthesis research
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


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
Force Concept Inventory

30 Questions

A stone dropped from the roof of a single story building to the surface of the earth:

(A) reaches a maximum speed quite soon after release and then falls at a constant speed thereafter.

(B) speeds up as it falls because the gravitational attraction gets considerably stronger as the stone gets closer to the earth.

(C) speeds up because of an almost constant force of gravity acting upon it.

(D) falls because of the natural tendency of all objects to rest on the surface of the earth.

(E) falls because of the combined effects of the force of gravity pushing it downward and the force of the air pushing it downward.
Force Concept Inventory

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 level at over 70 institutions and including data on over 35,000 students. Most notable is the study by Hake (1998) comparing FCI scores based on instructional method for over 6500 students.

Available on PhysPort!

Eleanor Sayre, esayre@ksu.edu
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
- Only US 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

12 beliefs and attitudes surveys available on PhysPort!

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Student Beliefs

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

"Ordinary" IE is not enough.

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.

Bias can be subtle. Need process measures.

PhysPort.org

Supporting physics teaching with research-based resources

Synthesis research

Faculty-centered online resources

go here now!
Faculty-centered online resources
Research and development process

1. Interview & survey faculty and chairs
2. Synthesize faculty needs
3. 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.
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Friendly articles that interpret and synthesize PER results for physics faculty.

- 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.

- 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.

- 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.

- 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?

physpo.org/recommendations

Have a suggestion?
esayre@ksu.edu
smckagan@aapt.org

Want to contribute?
Teaching Methods

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

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

physport.org/methods/
Curricular elements: ComPADRE

- Collections of teaching materials
- Free.
- Intro, upper division, astro, IPLS.... etc
- Simulations, tutorials, clicker questions, ebooks.... etc

ComPADRE is PhysPort's parent.
Open Source Physics

The OSP Collection provides curriculum resources that engage students in physics, computation, and computer modeling. Computational physics and computer modeling provide students with new ways to understand, describe, explain, and predict physical phenomena. Browse the OSP simulations or learn more about our tools and curriculum pieces below.

Tracker
The Tracker tool extends traditional video analysis by enabling users to create particle models based on Newton's laws. Because models synchronize with and draw themselves right on videos of real-world objects, students can test models experimentally by direct visual inspection.

EJS Modeling
Student modeling, the guided exploration of physical systems and concepts, is a powerful approach to engaged learning. Easy Java Simulations provides the computational tools for students and faculty to explore physics without the need for learning details of java programming.

Programming
Open Source Physics provides extensive resources for computational physics and physics simulations. Included are:

Newest OSP Materials
- May 26: Physlet® Waves and Oscillations Problems Package
- May 24: Physlet® Physics Periodic Motion Problems JS Package
- May 13: Solar and Lunar Eclipse JS Model
- Apr 24: Celestial Sphere with Analemma JS Model

Recently Updated Materials
- Jun 10: STP Textbook Chapter 9: Critical Phenomena
- Jun 10: STP Textbook Errata supplement
- May 8: Two-Body Orbits JS Model
- Mar 20: Open Source Physics Users Guide supplement
Advanced Labs

www.compadre.org/advlabs/

AAPT Summer Meeting 2017
Preparations are underway for the AAPT Summer meeting in Cincinnati, Ohio (July 22-26, 2017). The meeting will be held at the RiverCenter Convention Center. The main conference hotel is the Marriott Cincinnati RiverCenter. .
Interactive eBooks

www.compadre.org/books/SoundBook

www.compadre.org/books/?ID=15
Filing cabinet

- NFW collection
- Make your own collections!

bit.ly/compadre-nfw
Assessment Resources

PhysPort.org

- Search for RBAs
- Get administration details
- See sample questions
- See typical results
- Download RBAs
- Download usage guides

Verified educators!

For faculty and teaching staff
free, easy
Data Explorer

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

Upload your data

Explore your data

Download a report

Eleanor Sayre, esayre@ksu.edu
Data Explorer

![Secure]

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

physport.org/DataExplorer
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

physport.org/DataExplorer
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.

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
Data Explorer

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

physport.org/DataExplorer

Available now!
FCI, FMCE
CSEM, BEMA
CLASS, MPEX

Available soon!
80+
research-based assessments
Custom assessments for researchers and departments
Online workshops

Video workshops for training teaching assistants and faculty professional development in best practices
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 best facilitate a student discussion?

What is Periscope?

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?

Self Study
You can also use Periscope lessons for self-study by watching the video episodes 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 episodes, or opening both the episode and the handout on a large screen.

Handout

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.

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 $f_s$.

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?

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physport.org/periscope
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physport.org/periscope

Available now!

54 lessons
Facilitators' Guide
Resources

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

PhysPort can help.
Learn about better teaching!
Search for teaching methods
Read recommendations from experts

Be a PhysPort verified educator!
Download assessments
Take online workshops

Do Physics Education Research!
Discover how students learn
Build better pedagogy
Write part of your CAREER proposal

Email us to learn more:
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esayre@ksu.edu