PhysPort

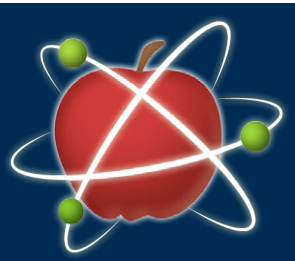
Supporting physics teaching with research-based resources

(Formerly known as the PER User's Guide)

Using research-based assessment to improve teaching in your classroom and department:

New resources on PhysPort.org

Sarah B. McKagan
Adrian Madsen
Eleanor C. Sayre



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

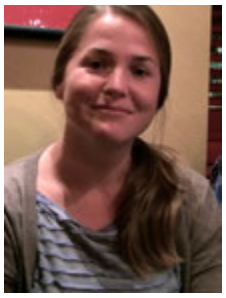
www.physport.org

Motivation

- Physics education researchers have created research results, teaching methods, curricula, and assessments that can dramatically improve physics education.
- Most people who teach physics don't know about these resources.
- There is a need for a "one-stop shopping" place to find resources for research-based teaching.

The PhysPort Team

AAPT


Sam McKagan (PI)
Adrian Madsen (co-PI)
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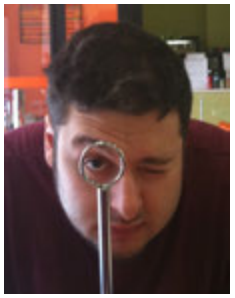
KSU





Ellie Sayre (PI)
Bill Hsu (development lead)
Eugene Vasserman (security lead)

Cognition Technology


Sandy Martinuk (user experience design lead)
Alex Bell (user experience design assistant)

PhysPort site content

Now available:

- Resources for research-based teaching
- **Resources for research-based assessment**
- Video workshops for LAs, TAs, & faculty:
  - Periscope (this morning): physport.org/periscope
  - Virtual New Faculty Workshop: physport.org/nfw

Coming in Fall 2015:

- Redesign and expansion of teaching methods
- **Assessment Data Explorer**
- Expert Recommendations

Research and Development Process

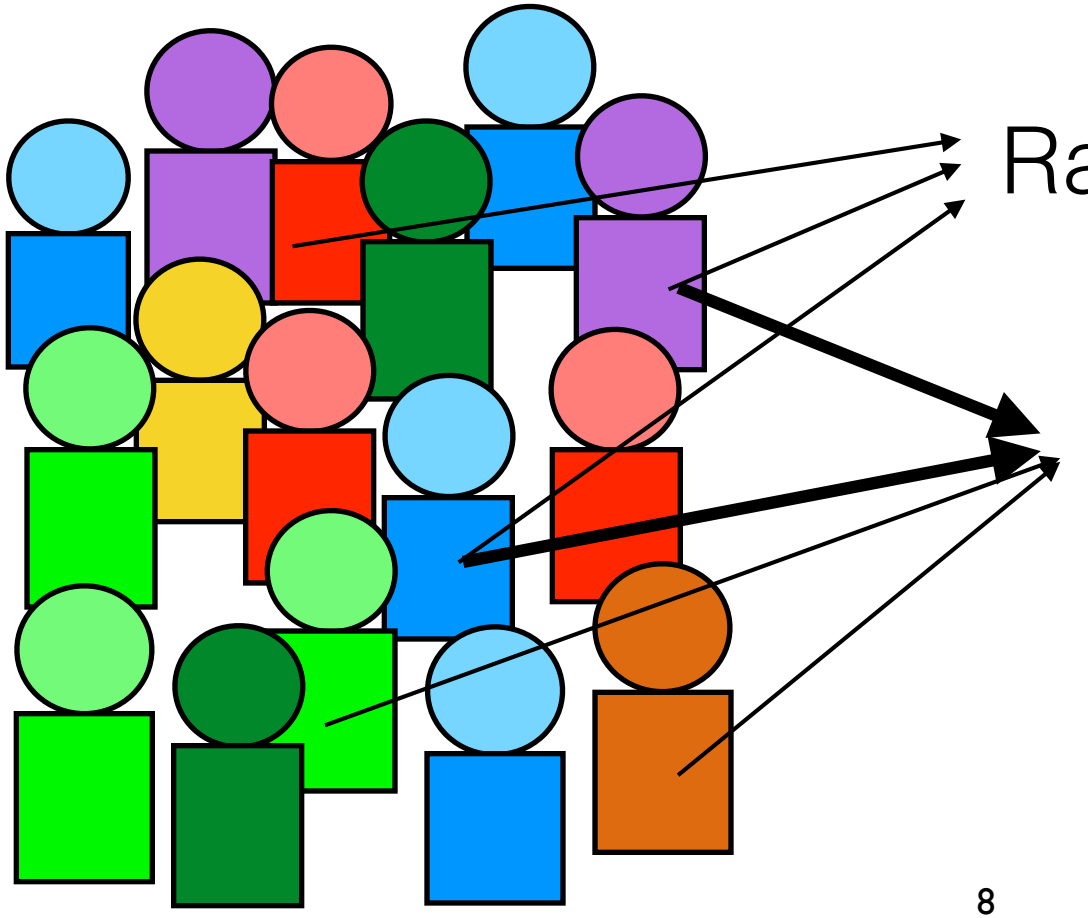
Faculty and Department Chair Interviews → Personas of Users → Site that meets real users' needs

Interviewed 24 physics faculty
and department chairs
about their teaching and assessment

(to discover goals, motivations, needs, pain points etc.)

Research and Development Process

Faculty and Department Chair Interviews → **Personas of Users** → Site that meets real users' needs



Raphael

Paula

Personas combine characteristics of many different people to represent a coherent set of user needs

Research and Development Process

Faculty and Department Chair Interviews → **Personas of Users** → Site that meets real users' needs

Paula the Skeptic

Raphael the Motivated Novice

Diane the Pragmatic Satisficer

Tim the Seeker

Marge the Proto-researcher

Key Personas

Raphael the Motivated Novice

- New to research-based teaching
- Cares about his students' learning, eager to try new methods
- Needs simple instructions and basic guidance

Diane the Pragmatic Satisficer

- Some experience with research-based teaching
- Wants to use evidence to demonstrate student learning.
- Wants to know what works, how to use it, and what to do if she has trouble.

Tim the Seeker

- Extensive experience with research-based teaching
- Wants to go beyond the basics and address less well-defined aspects of learning, such as problem solving, reasoning skills, and attitudes

Other personas (not used for site design)

Paula the Skeptic

- Not convinced that research-based teaching is effective
- Relies on intuition and experience to guide her teaching

Isn't going to use our site
(she'll learn from her colleagues who use the site)

Marge the Proto-researcher

- Extensive experience using and even creating research-based materials and strategies
- Knows where to find most resources she needs

Doesn't really need our site

Research and Development Process

Faculty and Department Chair Interviews → Personas of Users → **Site that meets real users' needs**

Examples from site:

- **Home page**
- Assessment resources
- Assessment data explorer

Start with biggest needs of users

Teaching Methods

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

Homepage

PhysPort
Supporting physics teaching with research-based resources

Login | Password

Search Entire Site GO

Home | Expert Recommendations | Teaching Methods | Assessment | 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
- find questions for my class
- get implementation help
- learn about pros and cons of PER-based teaching

read more on teaching >

Assessment

I want to...

- interpret assessment results
- assess the impact of reforms
- assess for accreditation
- assess advanced physics content or skills

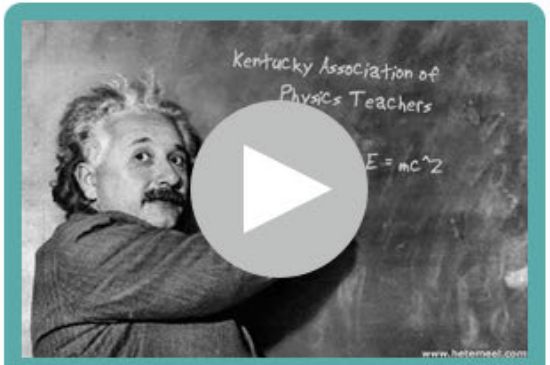
read more on assessment >

Troubleshooting

I need help with...

- covering enough material
- supporting group work
- arguments for skeptical colleagues
- arguments for skeptical students

read more on troubleshooting >



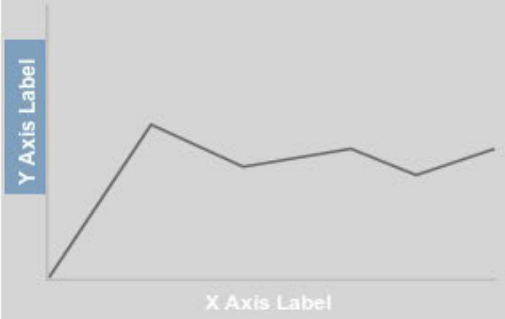
Featured Video - Modeling Instruction

Top ten results of physics education research that every physics instructor should know

by Sarah B. McKagan, Adrian Madsen, and Eleanor C. Sayre February 1, 2014

The field of physics education research (PER) is widely recognized as a leader in discipline-based science education research. Over the last four decades, researchers in PER have come to understand how students think about physics and have developed teaching methods that vastly improve student learning of physics. This article summarizes the results of PER that are more important for practicing physics educators to know and apply in their classrooms. We explain each result in enough detail that readers can easily understand why we believe each result to be true, and offer

NEW - Explore Assessment Data



Graph Caption - Tempus Mauris, Aliquam rhoncus tellus! Enim elementum ad quis Sociis Morbi ut eget

Blog

Research and Development Process

Faculty and Department Chair Interviews → Personas of Users → **Site that meets real users' needs**

Examples from site:

- Home page
- **Assessment resources**
- **Assessment data explorer**

How do we do assessment in physics?

Physics classes:

- Exams
- Homework
- Teaching evaluations
- Assessment surveys

Physics departments:

- Drop-withdraw-fail rates
- Student retention
- Observations
- Assessment surveys

Focus on research-based assessment surveys

What are Research-based Assessment Instruments?

Force Concept Inventory (FCI)
Force Motion Conceptual Evaluation (FMCE)
and 50+ more

These are:

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

Find an Assessment

Raphael the Motivated Novice

Diane the Pragmatic Satisficer

- Which research-based assessment should I use?
- Where do I get the assessment?

Tim the Seeker

- How can I assess non-content skills?

Browse Assessments

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

Any Subject | Any Level | Any Setting | Save Course | reset

Assessment Focus

Any

- Content knowledge
- Problem-solving
- Scientific Reasoning
- Lab skills
- Beliefs / Attitudes
- Interactive Teaching

Format

Any

- ☐ Multiple-choice
- ☐ Multiple-response
- ☐ Short answer
- ☐ Pre / Post
- ☐ Agree / Disagree
- ☐ Observational Protocol

Research Validation

Any

- ★ Gold Star Validation
- ☒ Validated Level 2
- ☒ Validated Level 1
- ☒ Research-Based

Content

Force Concept Inventory (FCI)

Mechanics Content Knowledge (Kinematics, Forces)
Introductory College
Multiple-choice, Pre/post
30 minutes

Representational Variant of the Force Concept Inventory (R-FCI)

Mechanics Content Knowledge (Kinematics, Forces)
Introductory College
Multiple-choice, Pre/post
30 minutes

Test of Understanding Graphs in Kinematics (TUG-K)

Mechanics Content Knowledge (Kinematics, Graphing)
Introductory College
Multiple-choice, Pre/post
30 minutes

Beliefs / Attitudes

Colorado Learning Attitudes about Science Survey (CLASS)

Beliefs / Attitudes

Learn about the Assessment

Raphael the Motivated Novice

Diane the Pragmatic Satisficer

- Which assessment should I use?
- Where do I get the assessment?
- How should I administer the assessment?

Tim the Seeker

- How can I assess non-content skills?

PhysPort beta
Supporting physics teaching with research-based resources

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Home | Expert Recommendations | Teaching Methods | Assessments | Workshops

Force Concept Inventory (FCI)

developed by David Hestenes, Malcolm Wells, and Gregg Swackhamer
http://modelinginstruction.org/researchers/evaluation-instruments/

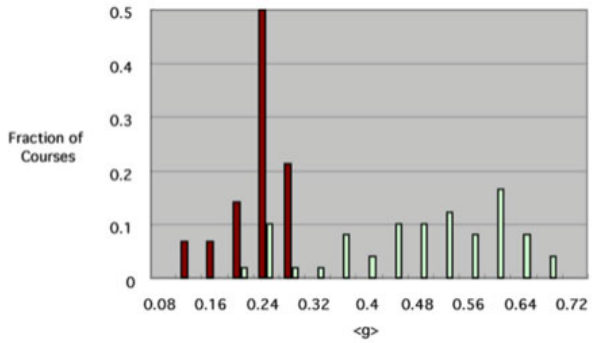
Multiple-choice, Pre/post

Duration 30 minutes

Focus Mechanics Content Knowledge (Kinematics, Forces)

Level Introductory

Typical Results



Explore More 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
- Statistical analysis

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

Related Expert Recomendations — view all >

- **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 — view all >

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

and even guides to running your own workshop

Examples | Resources | Research | Translations | Variations

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

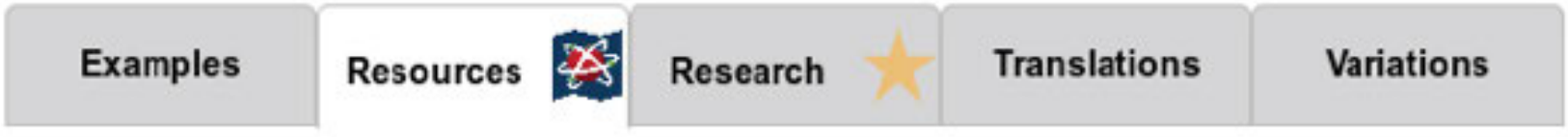
(A) 1 only

(B) 1 and 2

(C) 1, 2, and 3

(D) 1, 2, and 4

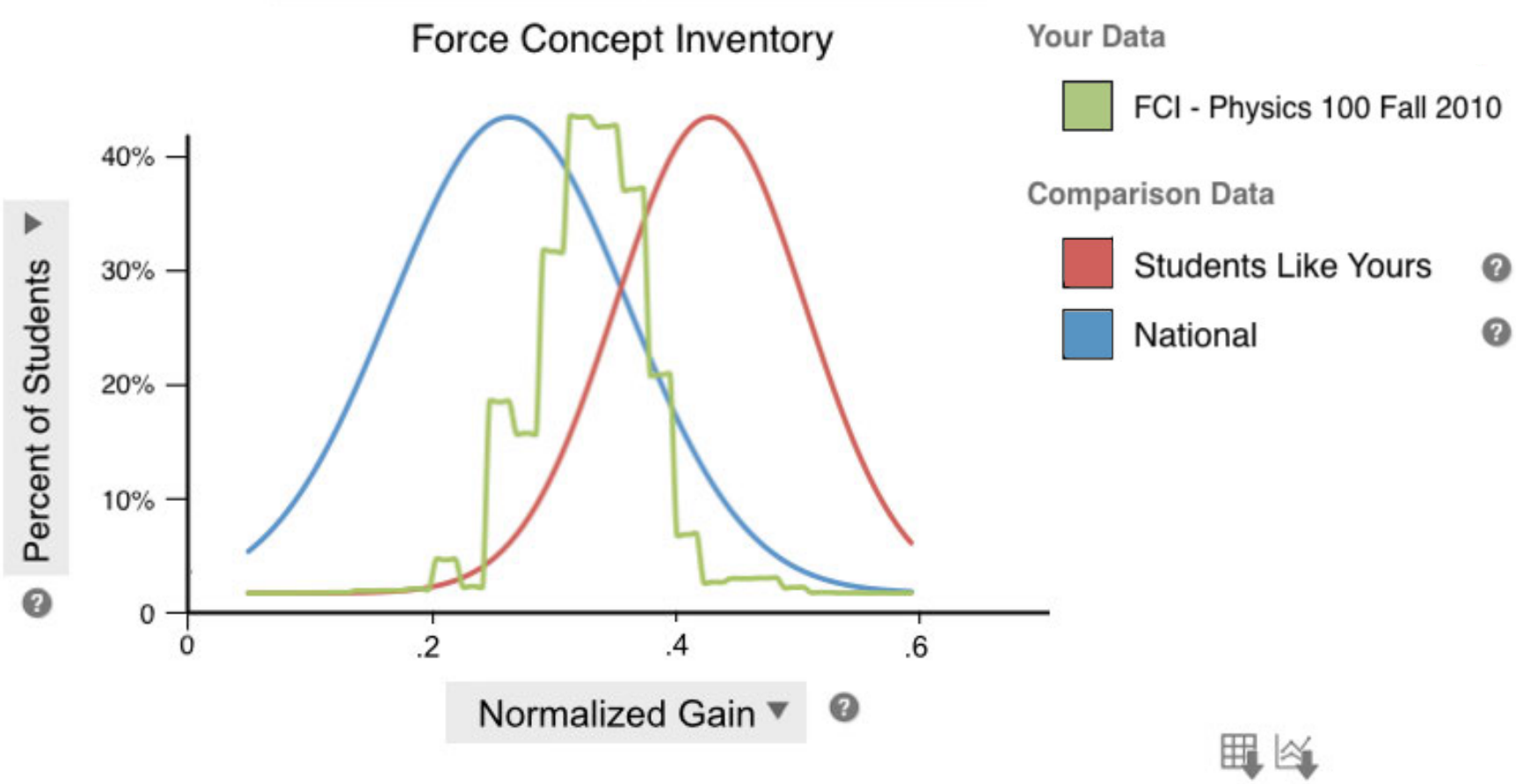
(E) none of these, since the book is at rest there are no forces acting on it.



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**.

Visualize and Analyze Your Assessment Data



Visualize and Analyze Your Assessment Data

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

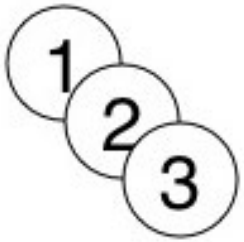
Visualize and Analyze Your Assessment Data

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.

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.



Easy

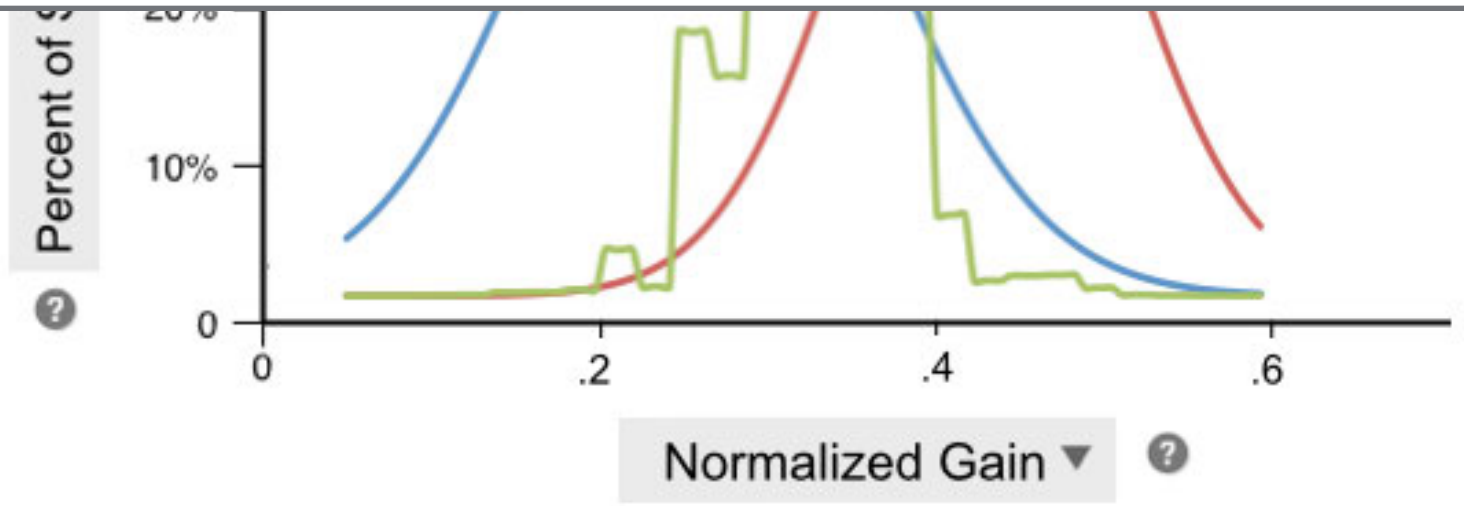
Our guided process makes it easy to upload your data, and our visualization engine is tailored to assessments, making charting a snap.

Visualize and Analyze Your Results

Histogram For	Your Course	Breakdown By	Compare

Raphael the Motivated Novice

- How did I do on this assessment?
- How do my assessment results compare to other students like mine?



Visualize and Analyze Your Results

Your Data Split

FCI - Physics 100 Fall 2010

Comparison Data

Students Like Yours

National

Summary

0.3
Average Gain

Your students' average normalized gain of 0.3 is similar to the national average but statistically lower than "students like mine". This means that students at similar institutions in similar course have higher gains than your students.

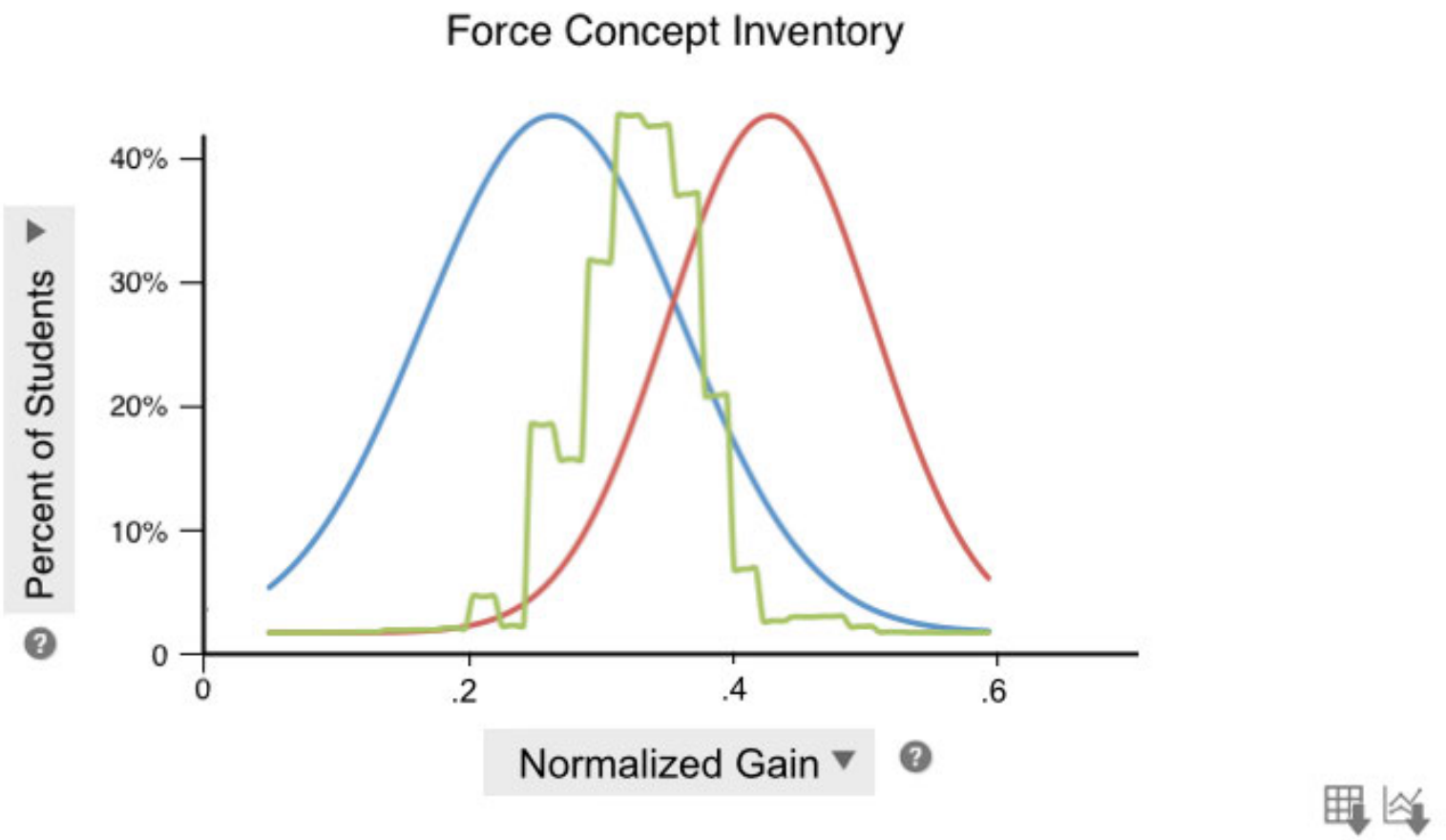
Courses taught using interactive engagement techniques have gains in the range from .18 to .66 with an average of . 48. Your normalized gain is in the lower end of this range.

Recommendations

Large courses like yours that are taught using interactive engagement techniques tend to have higher normalized gains. 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 Simulations, Interactive Lecture Demos and Just In Time Teaching.

Histogram For Your Class | Your Course Over Time | Breakdown By Question | Compare Multiple Courses



Your Results Over Time

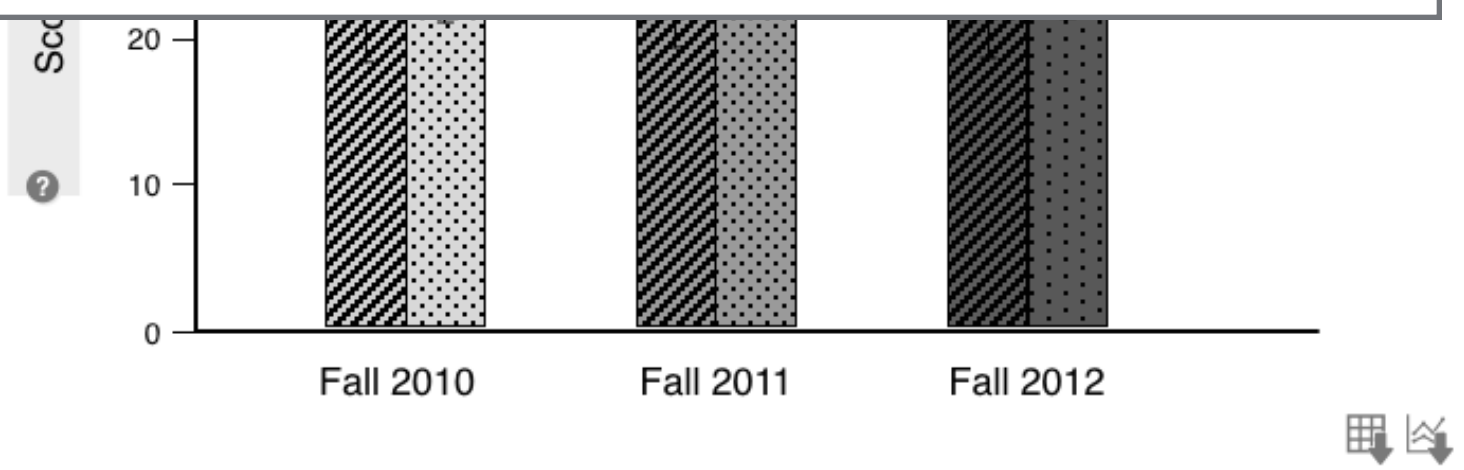
Your Data Group | Split

ECL - Physics 100 Fall 2010

Histogram For Your Class | Your Course Over Time | Breakdown By Question | Compare Multiple Courses

Diane the Pragmatic Satisficer

- How do my results change over time?



Your Results Over Time

Your Data Group | Split

FCI - Physics 100 Fall 2010

FCI - Physics 100 Fall 2011

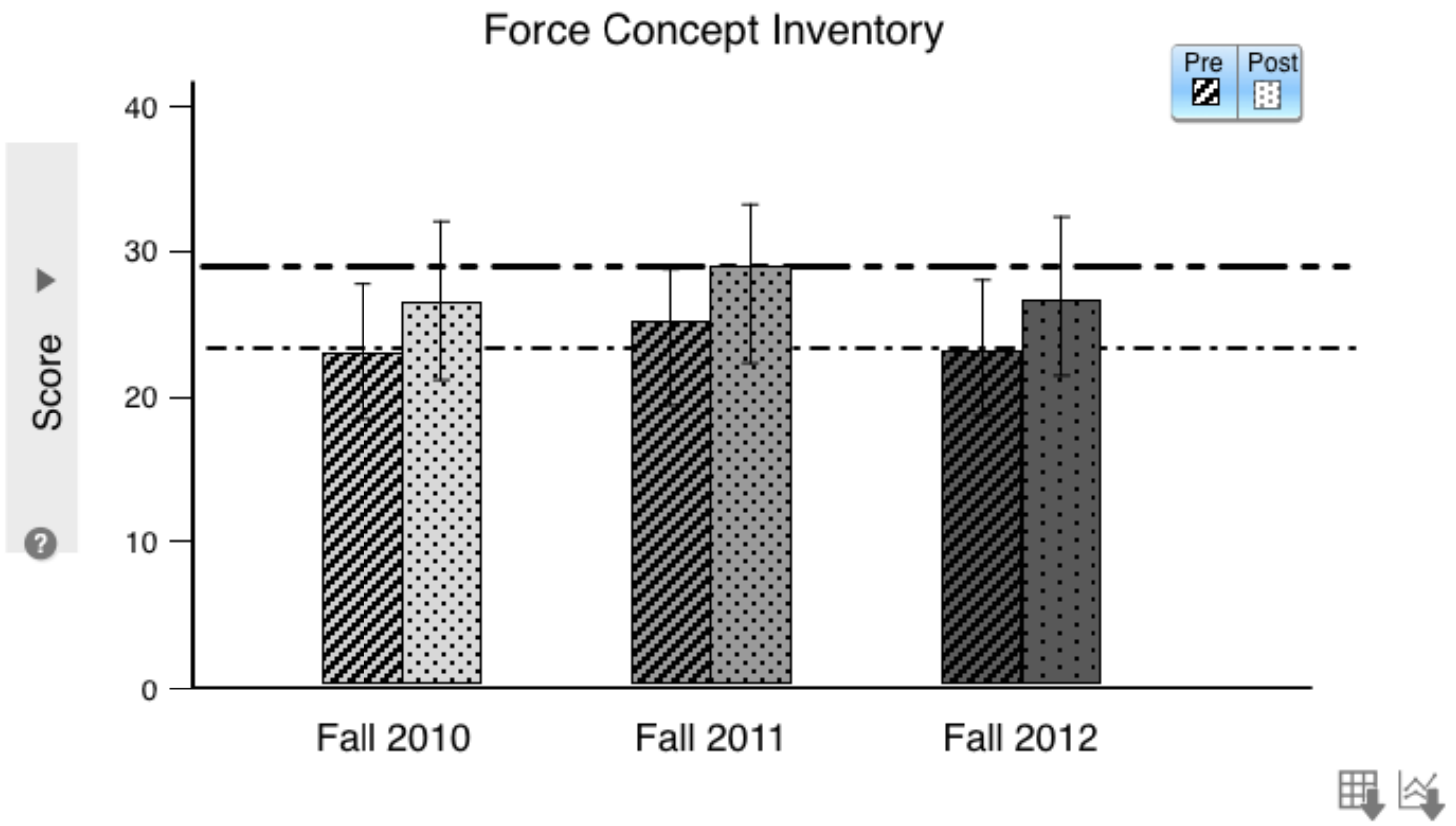
FCI - Physics 100 Fall 2012

Comparison Data

Students Like Yours

National Median

Histogram For Your Class | **Your Course Over Time** | **Breakdown By Question** | **Compare Multiple Courses**



Your Results Over Time

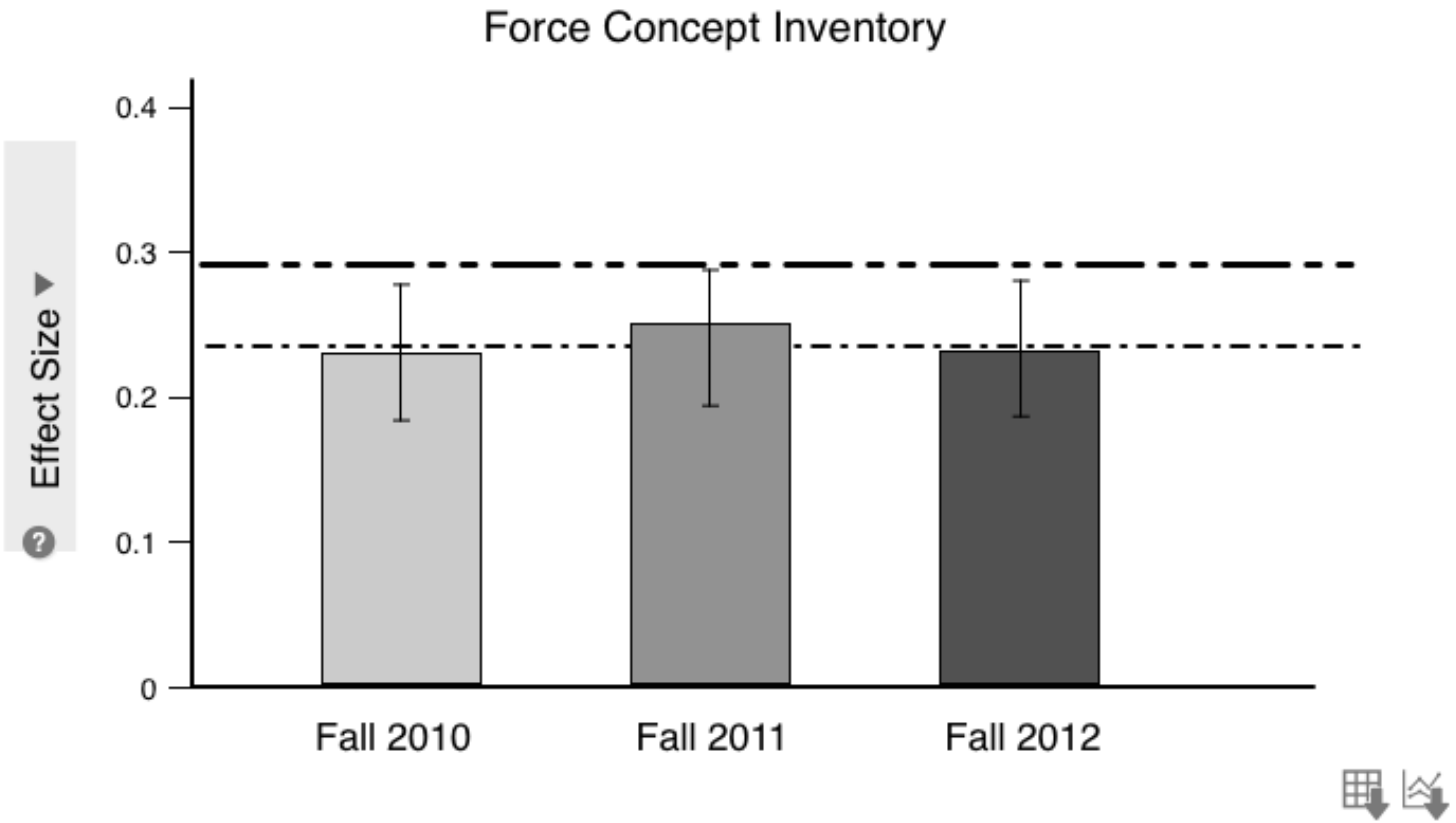
Your Data Group | Split

- FCI - Physics 100 Fall 2010
- FCI - Physics 100 Fall 2011
- FCI - Physics 100 Fall 2012

Comparison Data

- Students Like Yours
- National Median

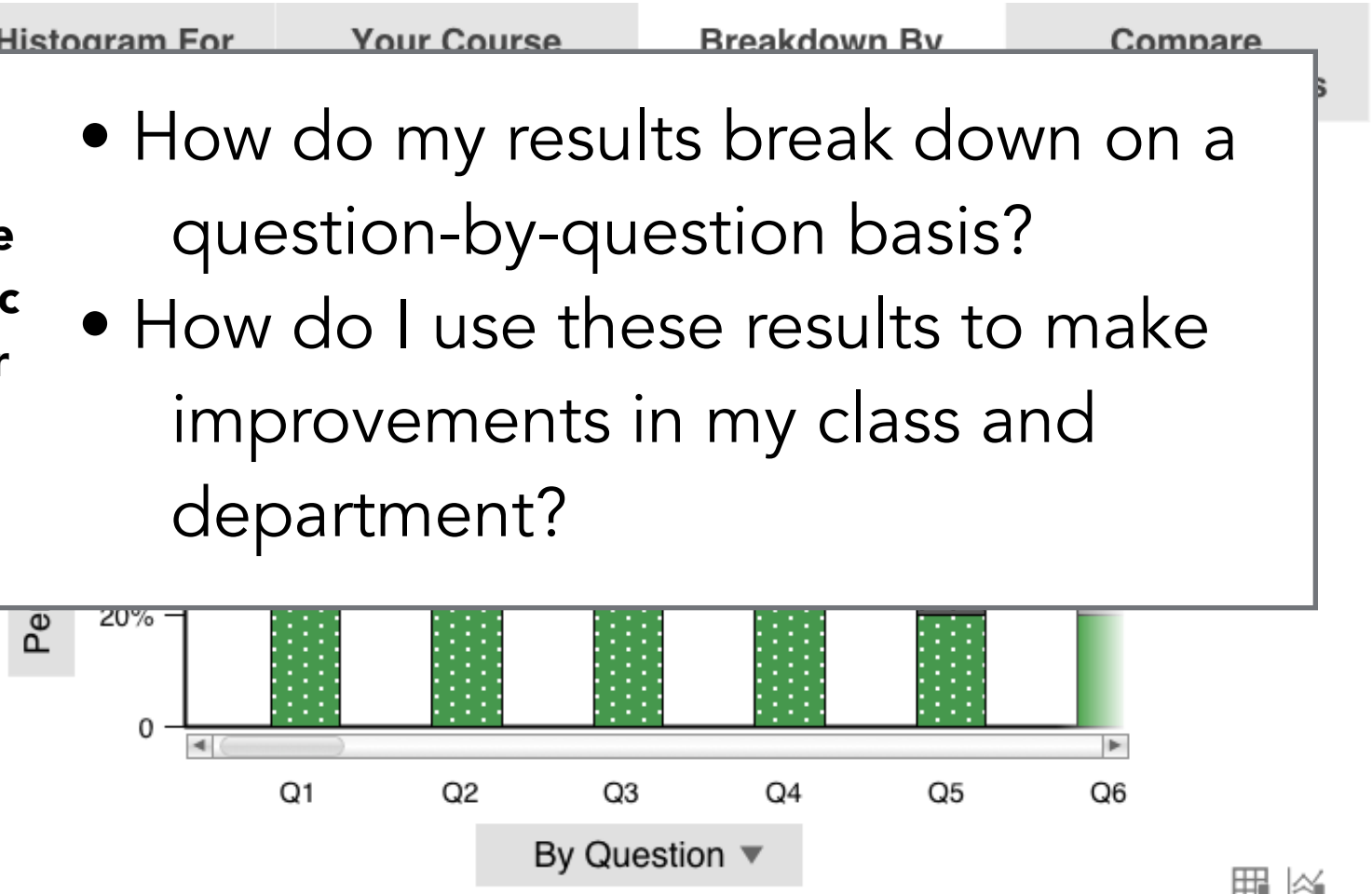
Histogram For Your Class | **Your Course Over Time** | **Breakdown By Question** | **Compare Multiple Courses**



Question-by-Question Breakdown

Diane the Pragmatic Satisficer

- How do my results break down on a question-by-question basis?
- How do I use these results to make improvements in my class and department?



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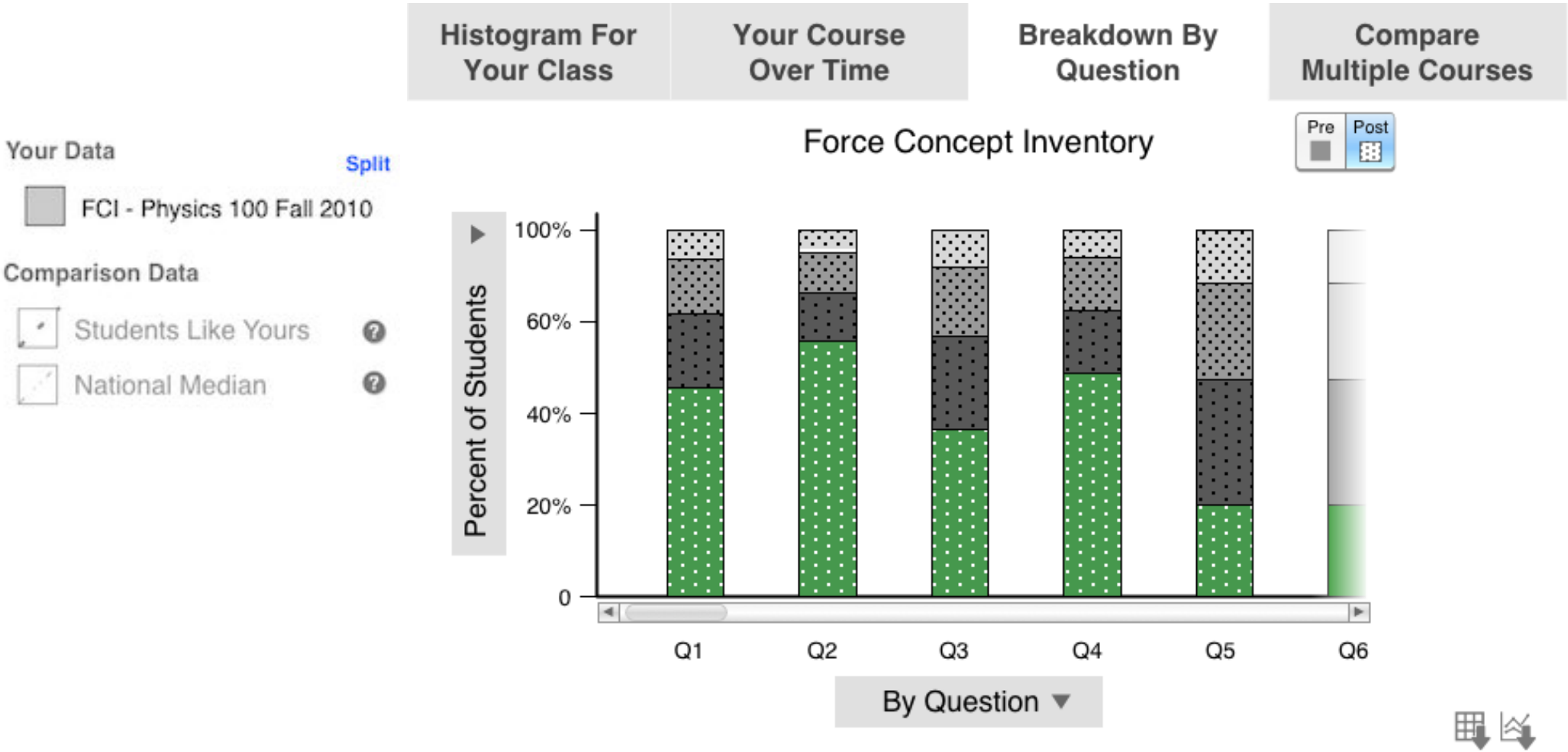

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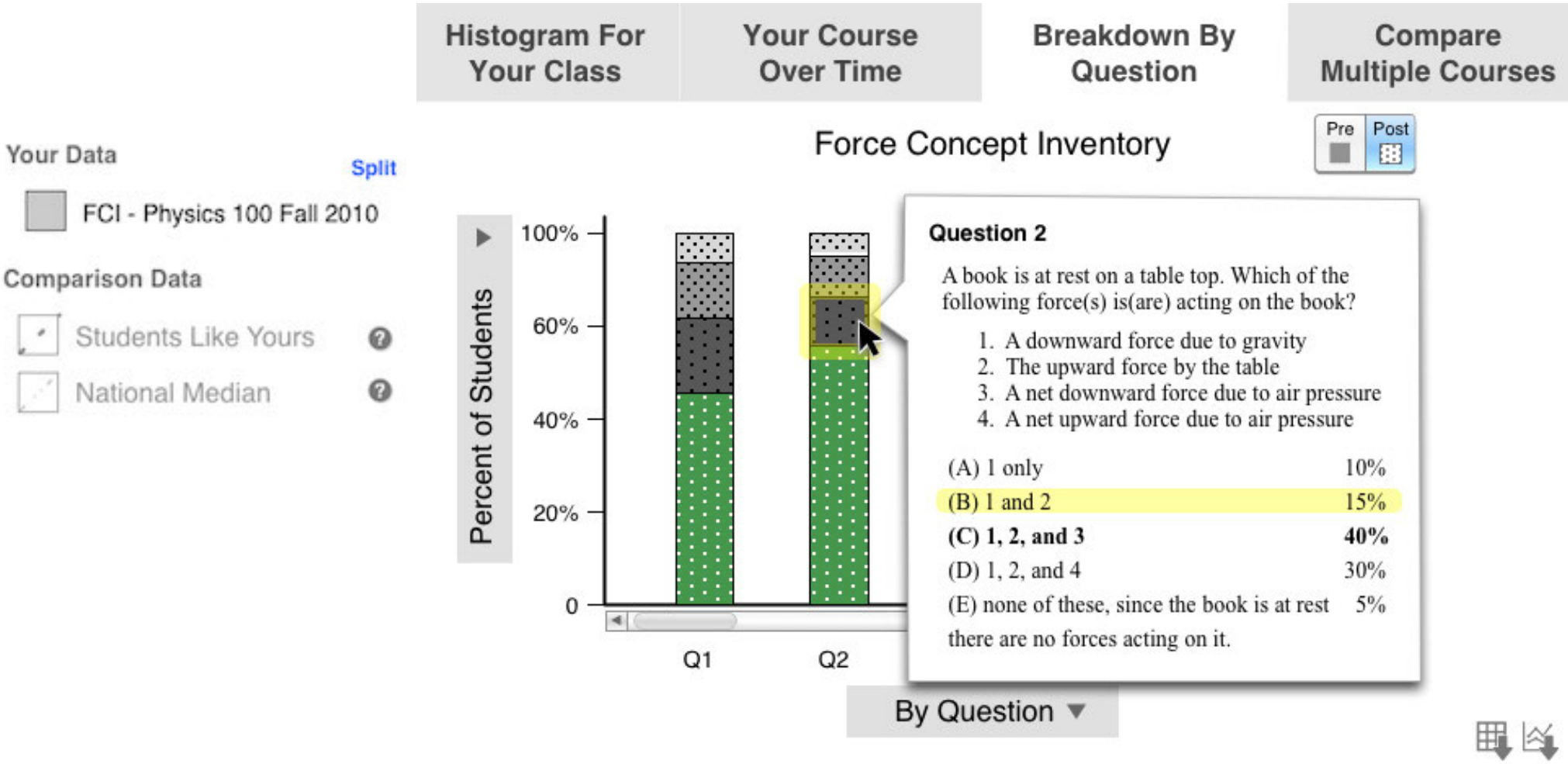

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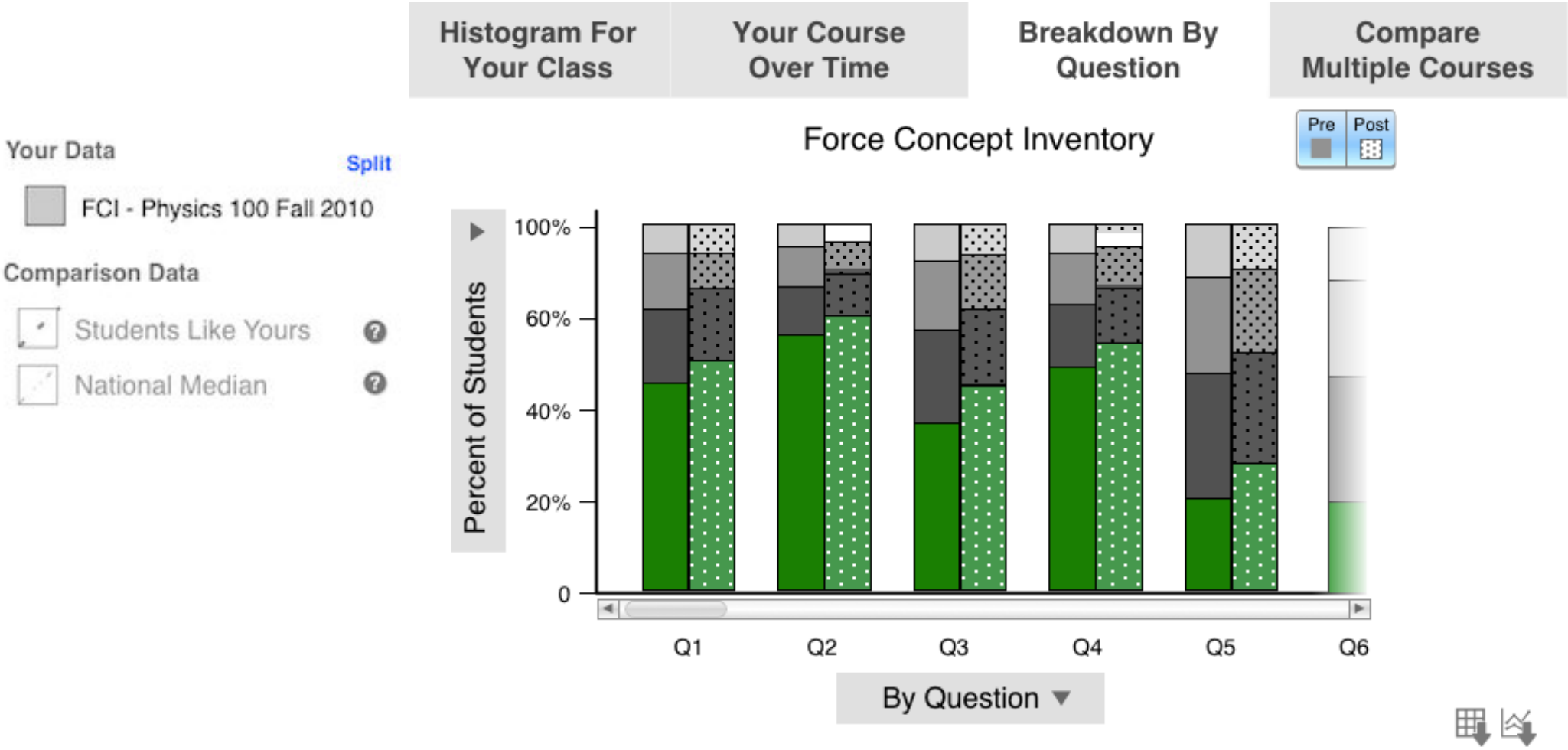

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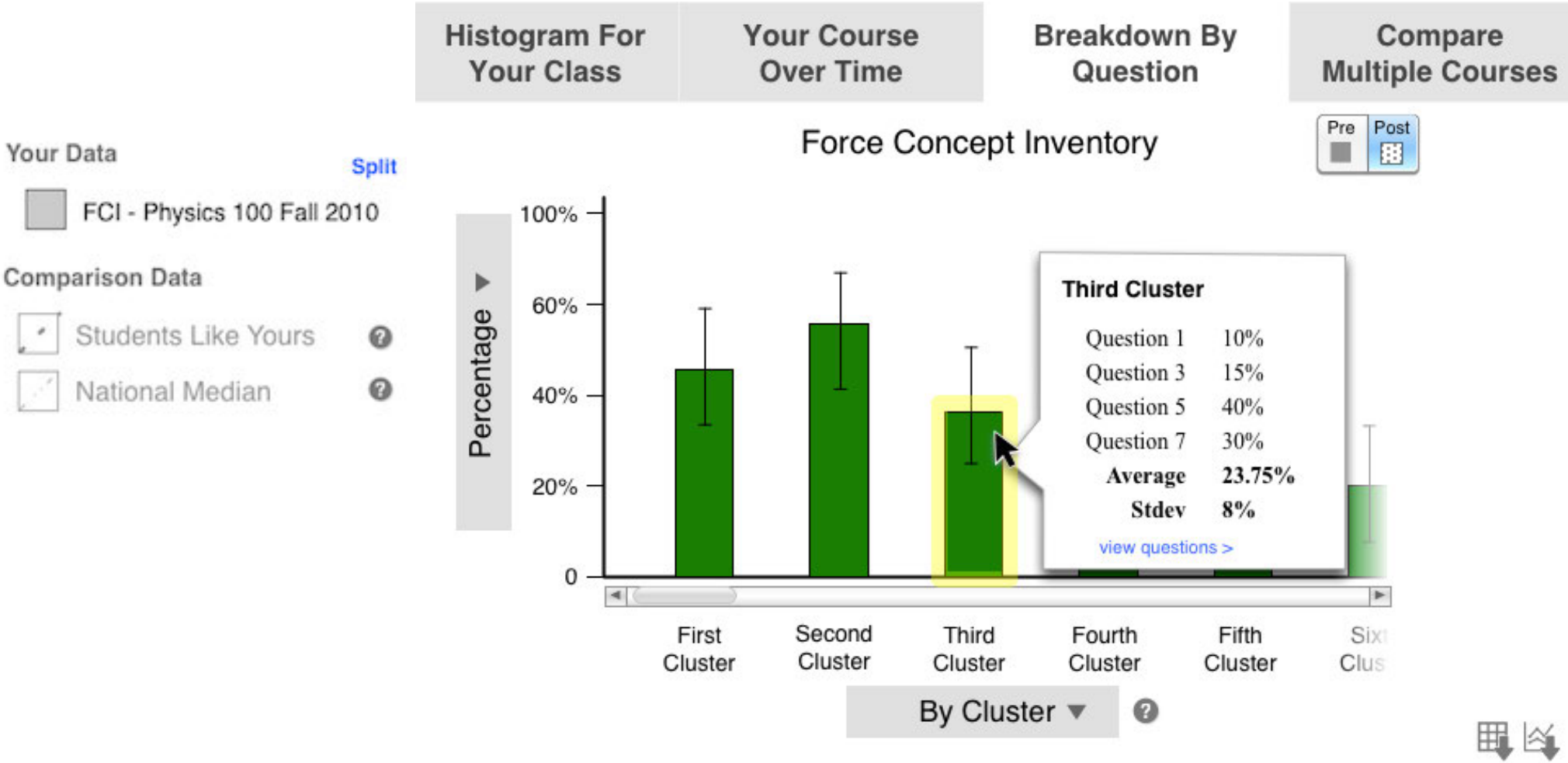


Compare Multiple Courses

Tim the Seeker

- How do the results in my department vary across different courses and instructors?
- Is there a gender gap on these assessments in my class?

Histogram For | Your Course | Breakdown By | Compare

Comparison Data

Students Like Yours

National Average

Ef

0.1

0

Physics 100 Fall 2010 | Physics 100 Fall 2011 | Physics 100 Fall 2012 | Physics 101 Fall 2010 | Physics 101 Fall 2011 | Physics 101 Fall 2012

Compare Multiple Courses

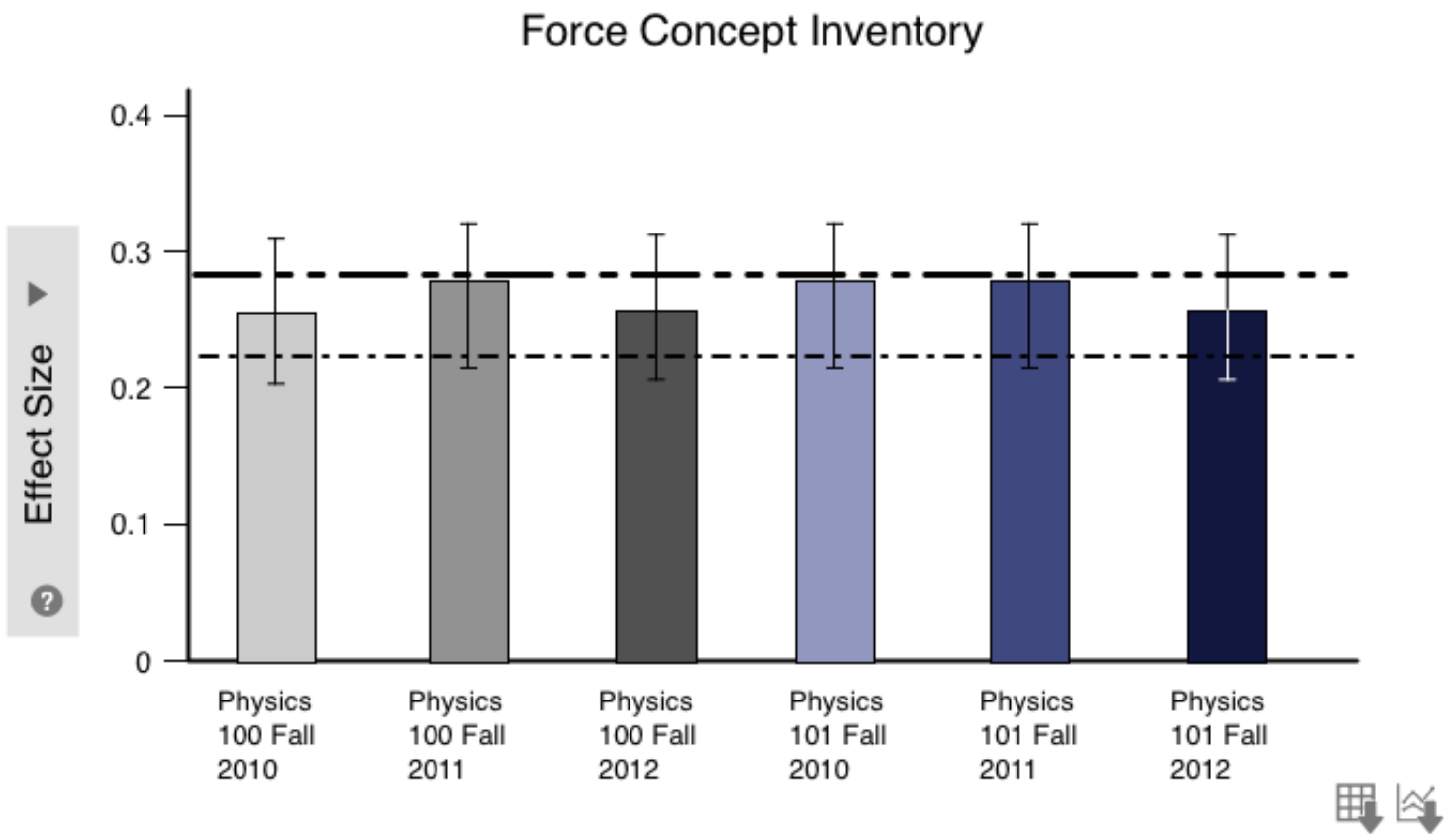
Histogram For Your Class	Your Course Over Time	Breakdown By Question	Compare Multiple Courses

Your Data Group | Split

- FCI - Physics 100 Fall 2010
  Add Post Data
- FCI - Physics 100 Fall 2011
- FCI - Physics 100 Fall 2012
- FCI - Physics 101 Fall 2010
- FCI - Physics 101 Fall 2011
- FCI - Physics 101 Fall 2012

Comparison Data

- Students Like Yours
- National Average



Compare Multiple Courses

Histogram For Your Class	Your Course Over Time	Breakdown By Question	Compare Multiple Courses

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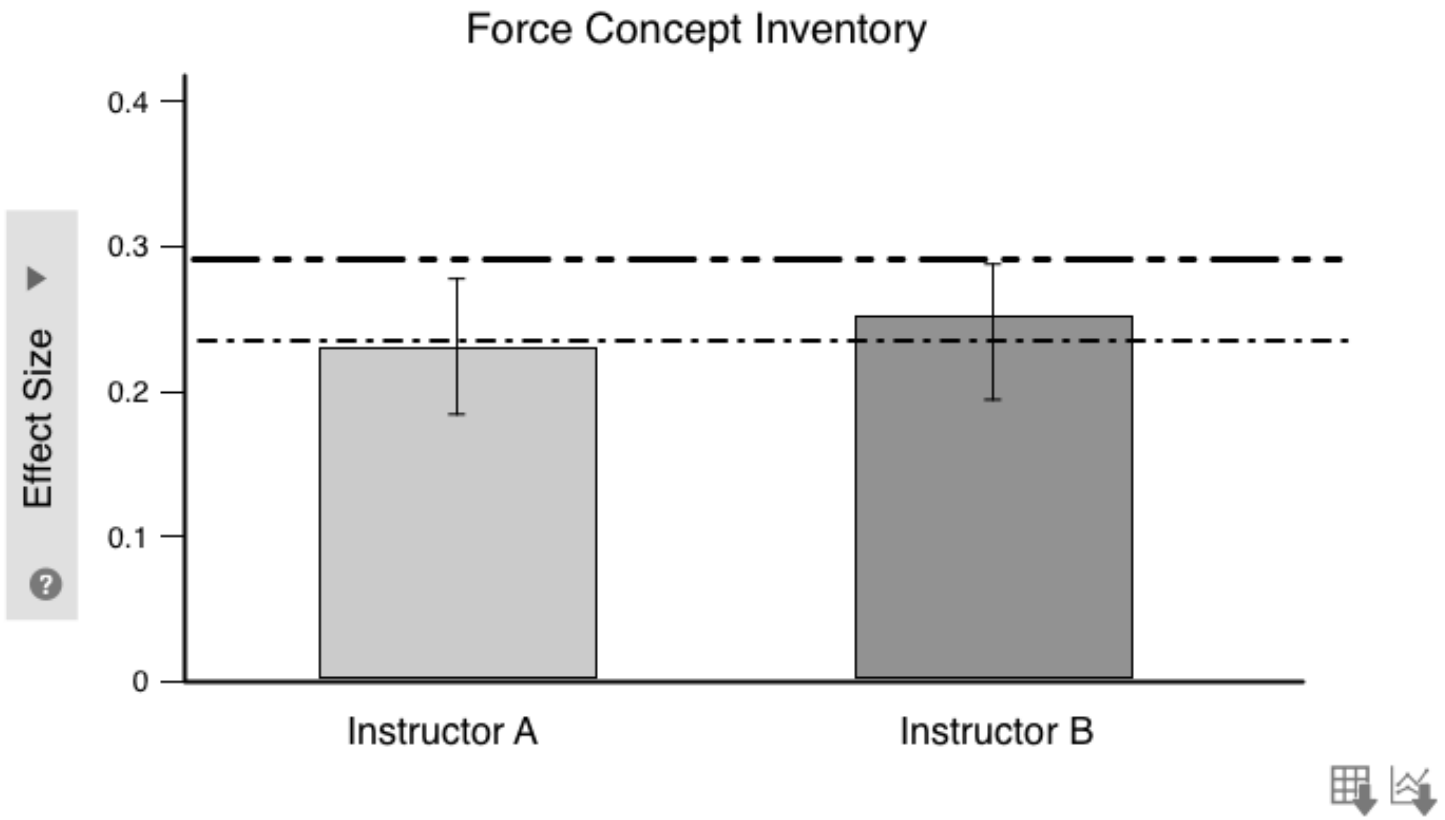
Comparison Data

- Students Like Yours
- National Average



Compare Multiple Courses

Histogram For Your Class	Your Course Over Time	Breakdown By Question	Compare Multiple Courses

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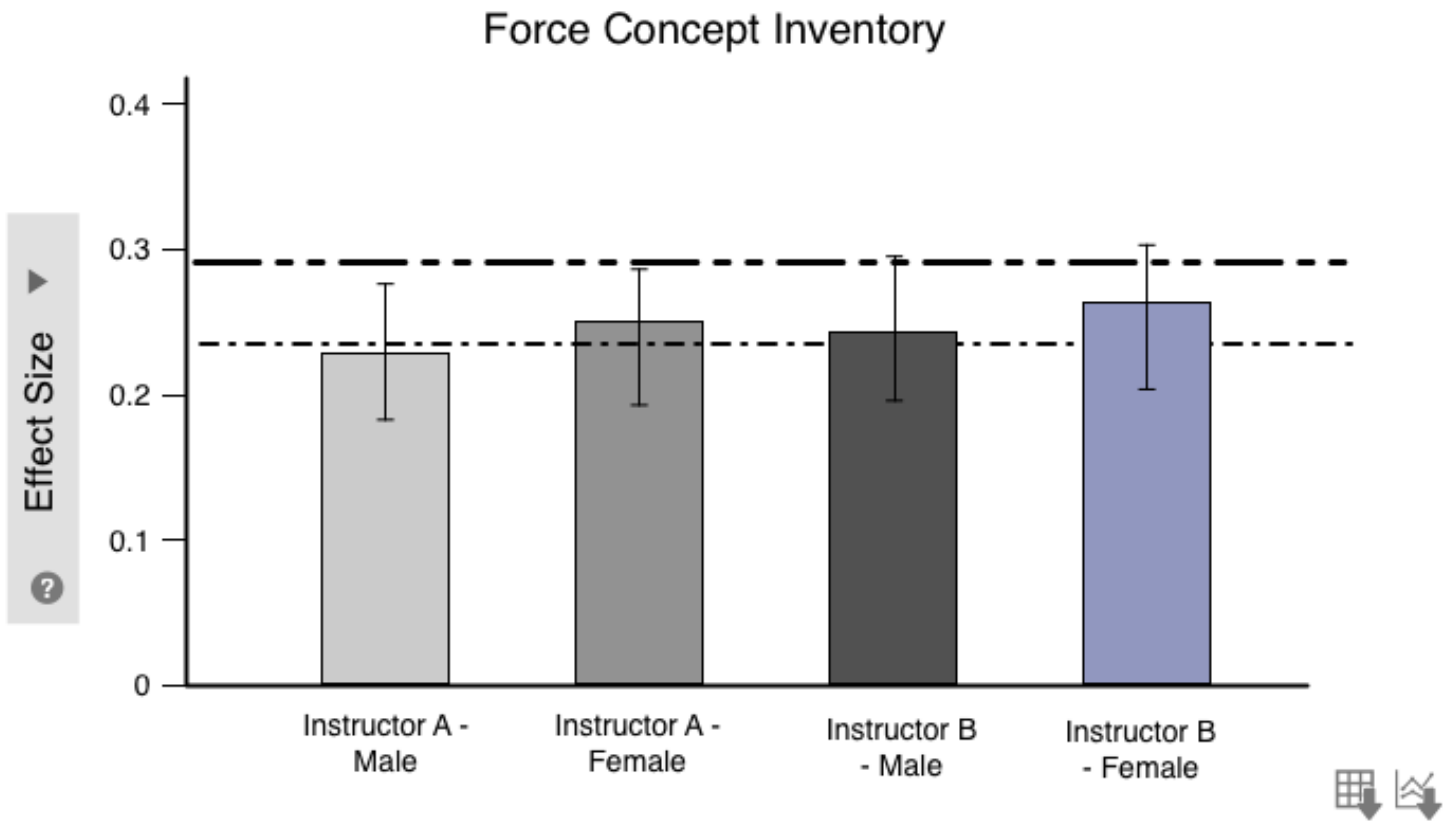
Comparison Data

- Students Like Yours
- National Average



Upload Assessment Results

Raphael the Motivated Novice

Diane the Pragmatic Satisficer

- When will I find the time to analyze my data?

Upload Assessment Results

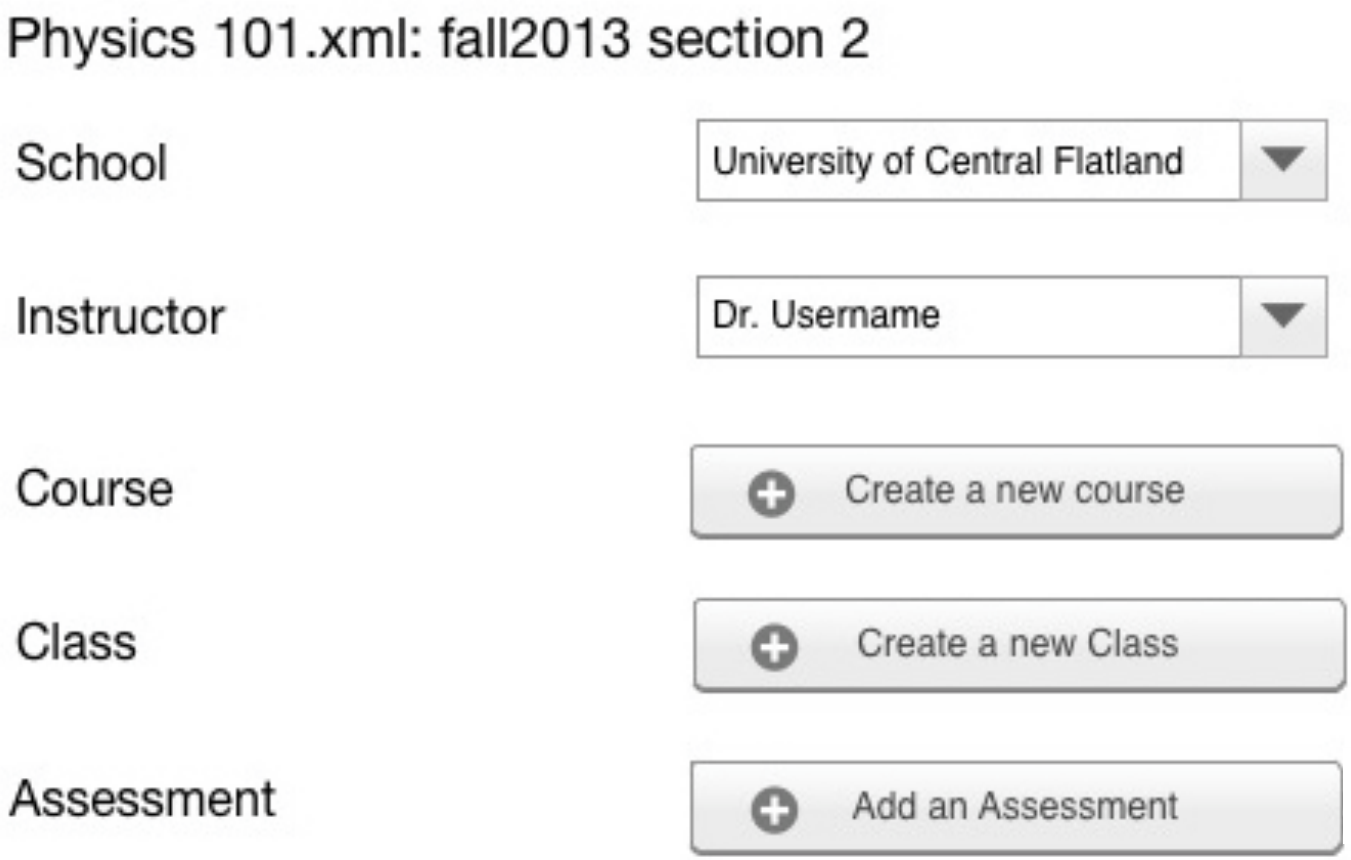
Upload your data file

Add metadata to tell us what's in your file

Review and confirm your import

Visualize the results

Add Metadata



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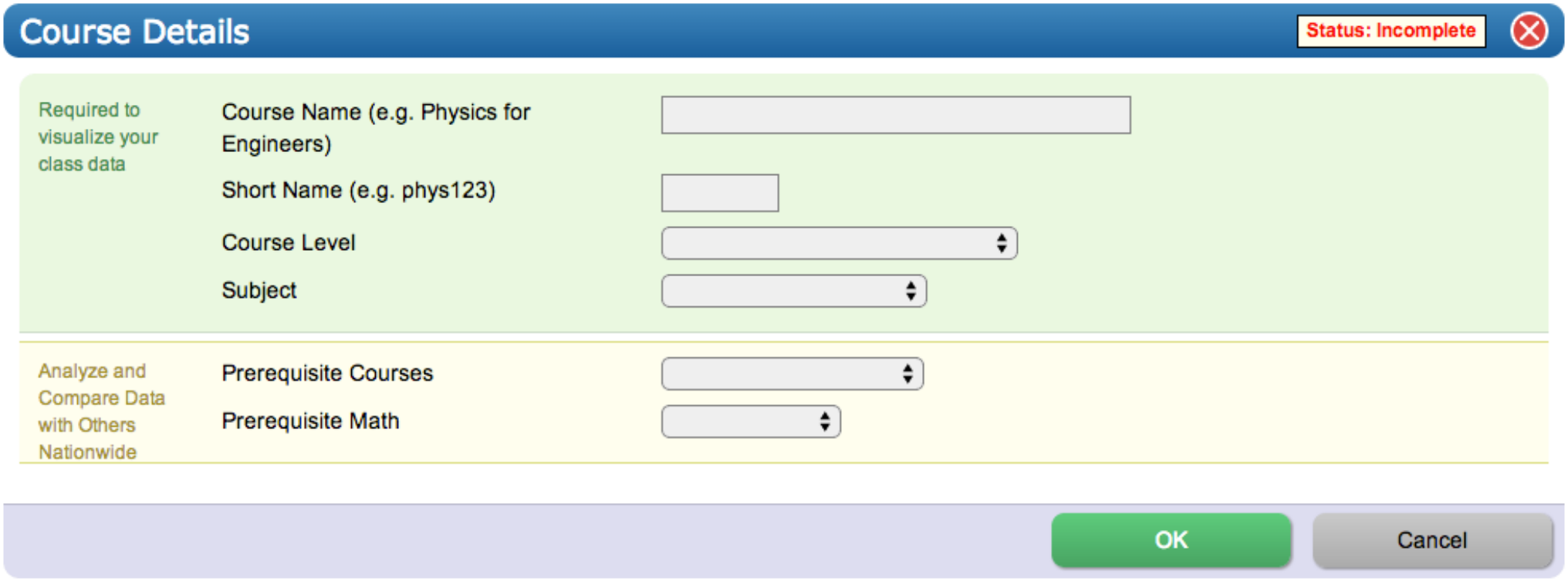

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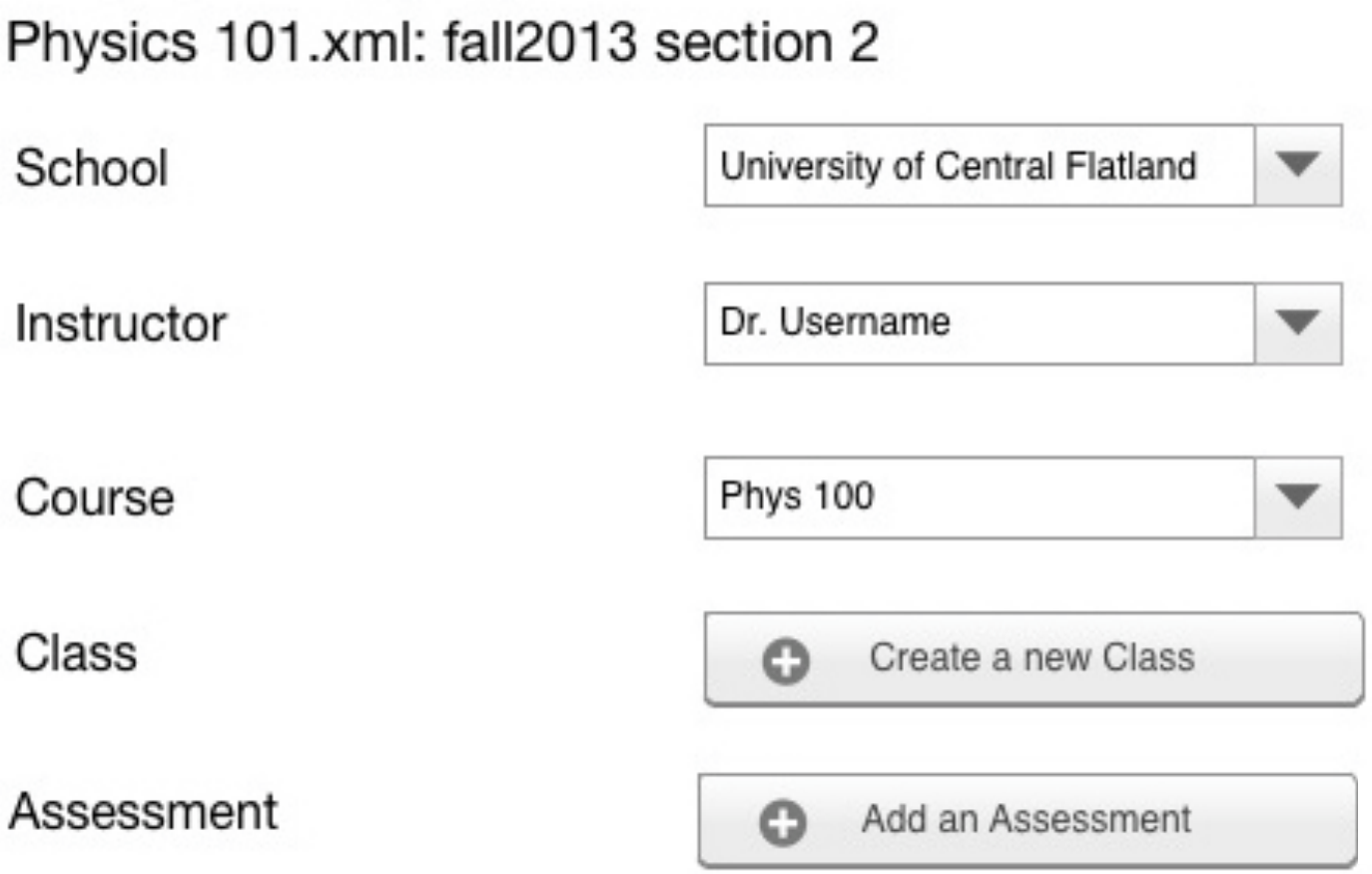


Class Details

Status: Saved

Required to visualize your class data

Term class was taught: Fall * 2014 *

Course Length 12 weeks

Analyze and Compare Data with Others Nationwide

Section Number

Minutes Per Week minutes

Average student rating for class: out of

In-class activities

Think about a typical day in this class. Which of the following activities do your students engage in for a substantial amount of time?

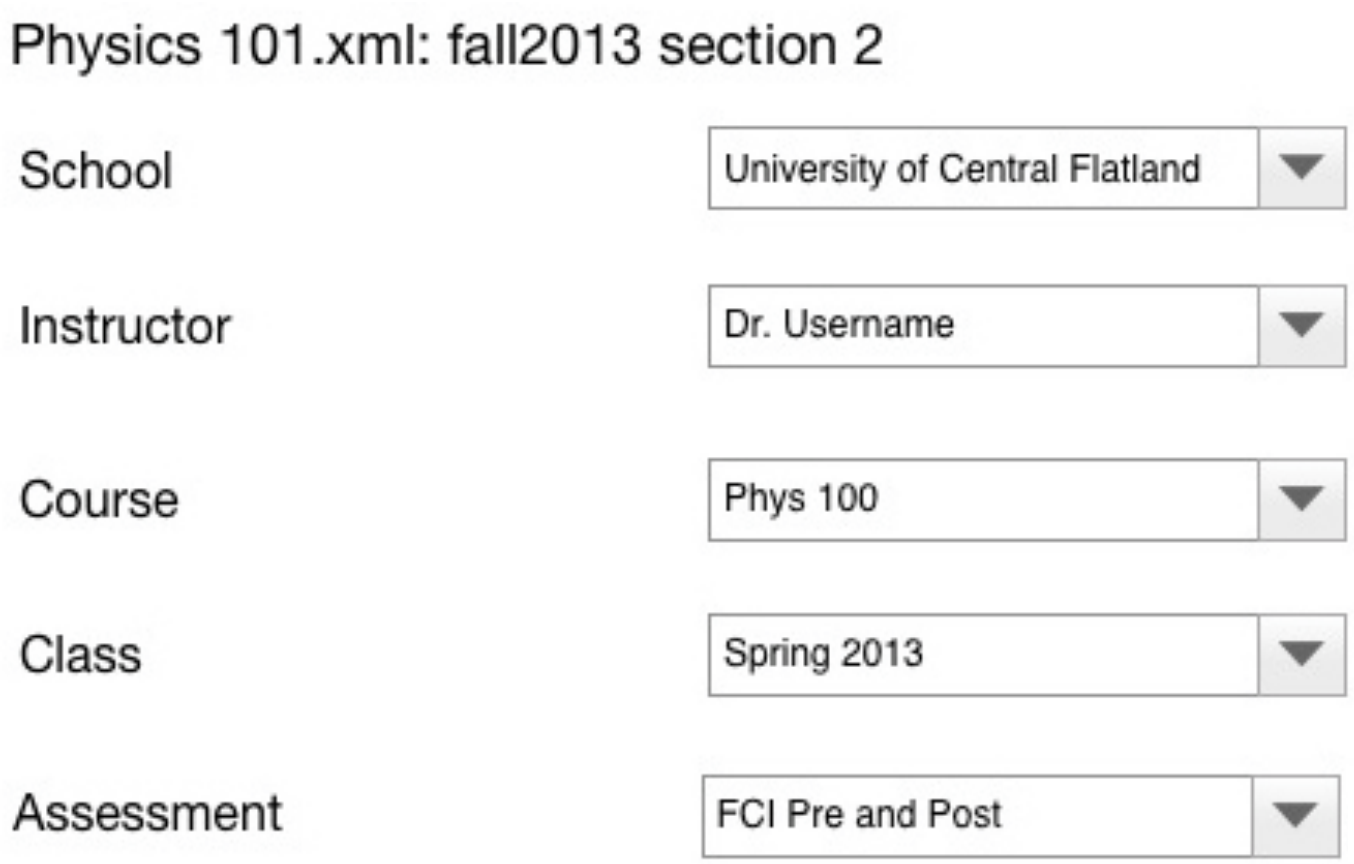
- [ ] Talking to or working with each other in small groups
- [ ] Working individually
- [ ] Listening to (or taking notes during) lecture
- [ ] Presenting to the whole class
- [ ] Engaging in whole-class discussion
- [ ] Other:

Out-of-class activities

Which of the following activities are students supposed to spend a substantial amount of time on outside of class?

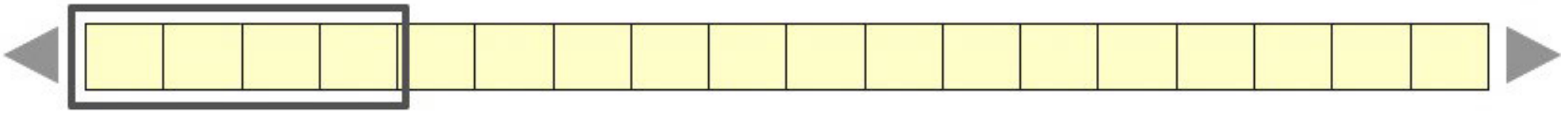
- [ ] Homework problems
- [ ] Write up lab reports
- [ ] Watch video lectures
- [ ] Read textbook; Which one?
- [ ] Investigate simulations
- [ ] Work with other students
- [ ] Projects
- [ ] Other:

Add Metadata



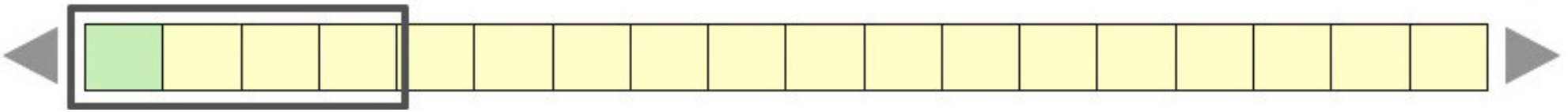
Confirm Auto Guesses in Your File

A	B	C	D
? Student ID	? TOEFL Score	? FCI Q1	? FCI Q2
ID Number	Course Grade	Q1	Q2
252654	75	B	B
652365	80	C	G
652365	95	D	D

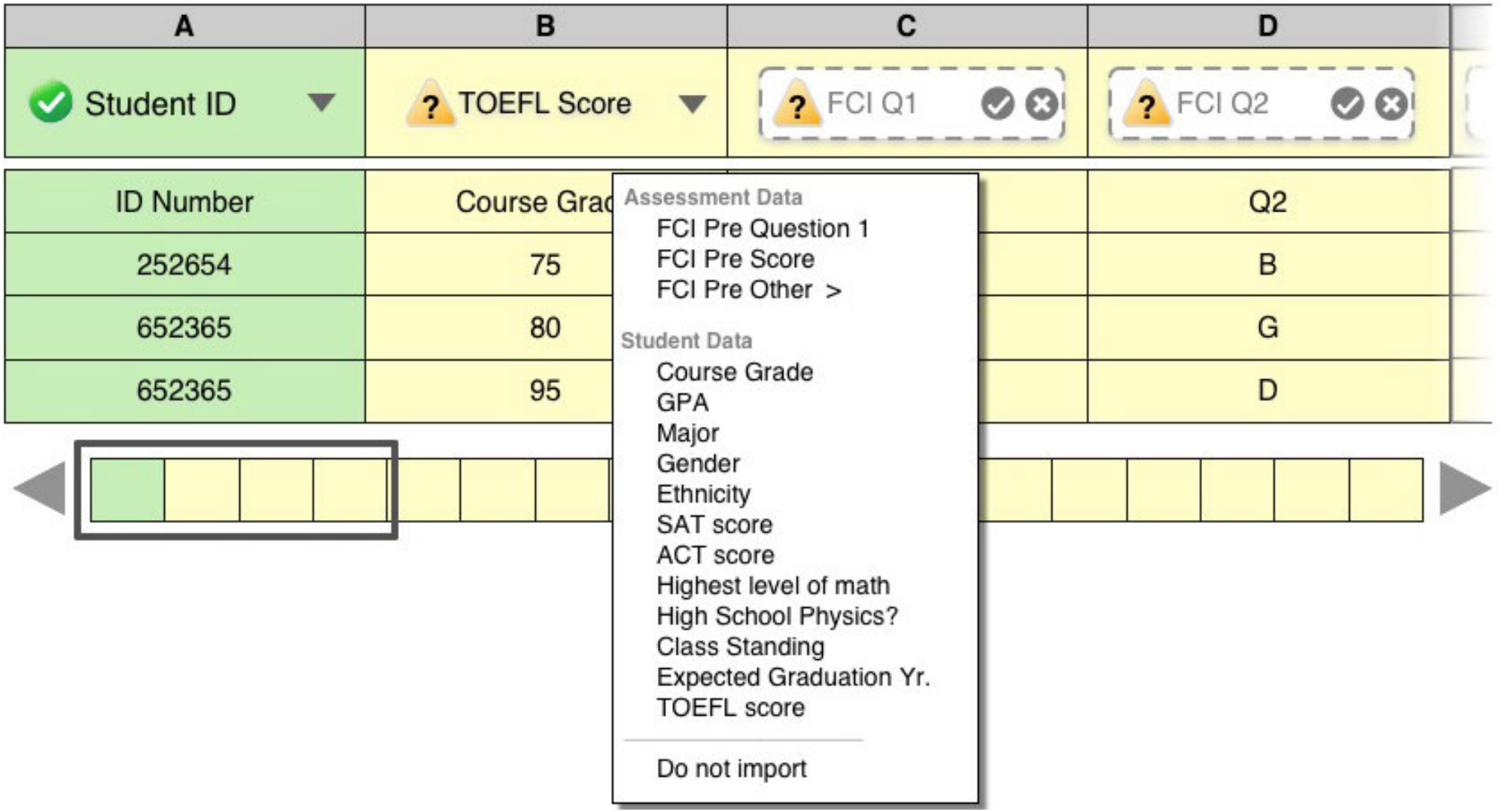


Confirm Auto Guesses in Your File

A	B	C	D
Student ID	TOEFL Score	FCI Q1	FCI Q2
ID Number	Course Grade	Q1	Q2
252654	75	B	B
652365	80	C	G
652365	95	D	D

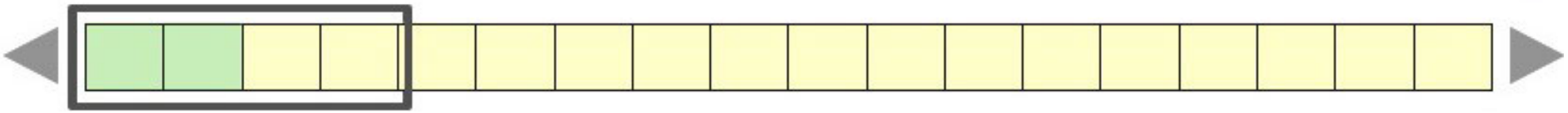


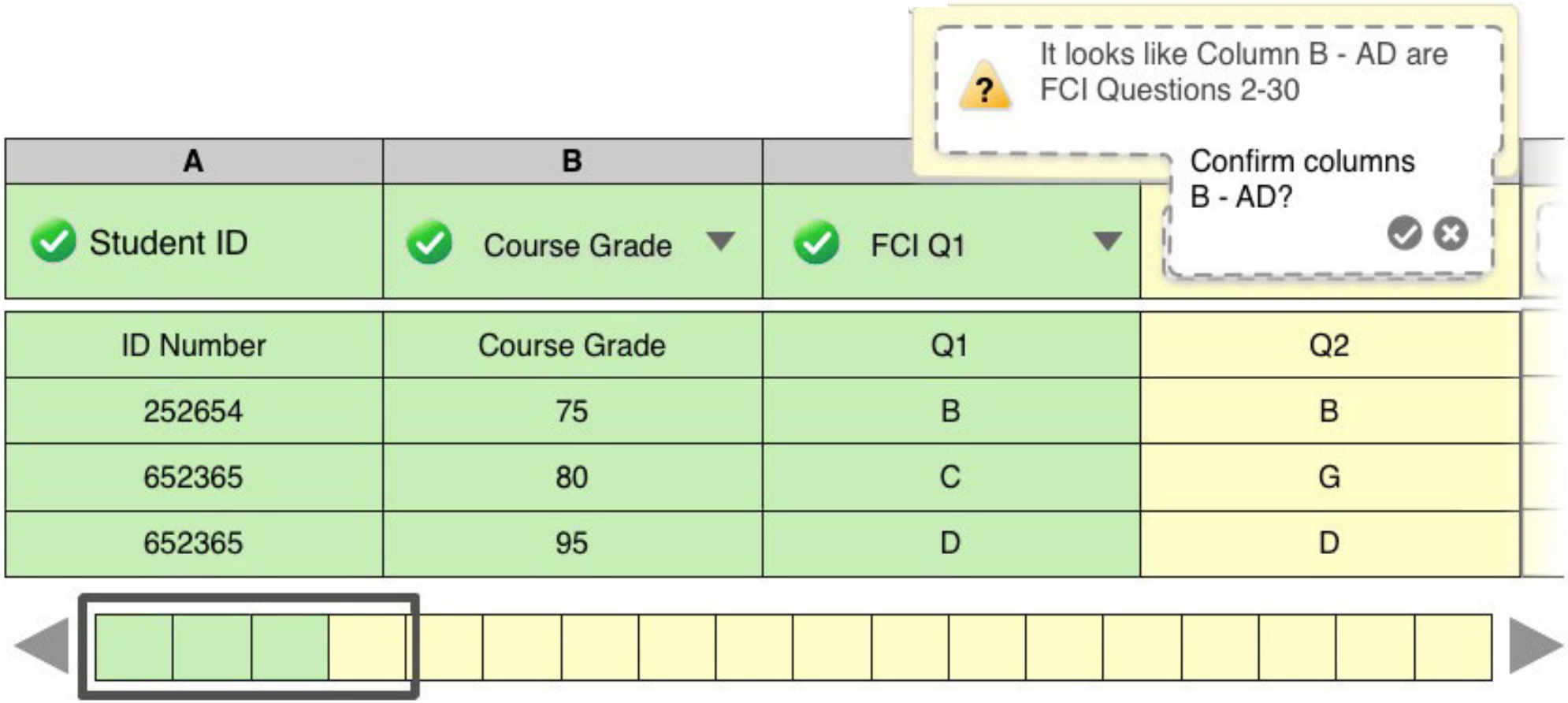
Confirm Auto Guesses in Your File

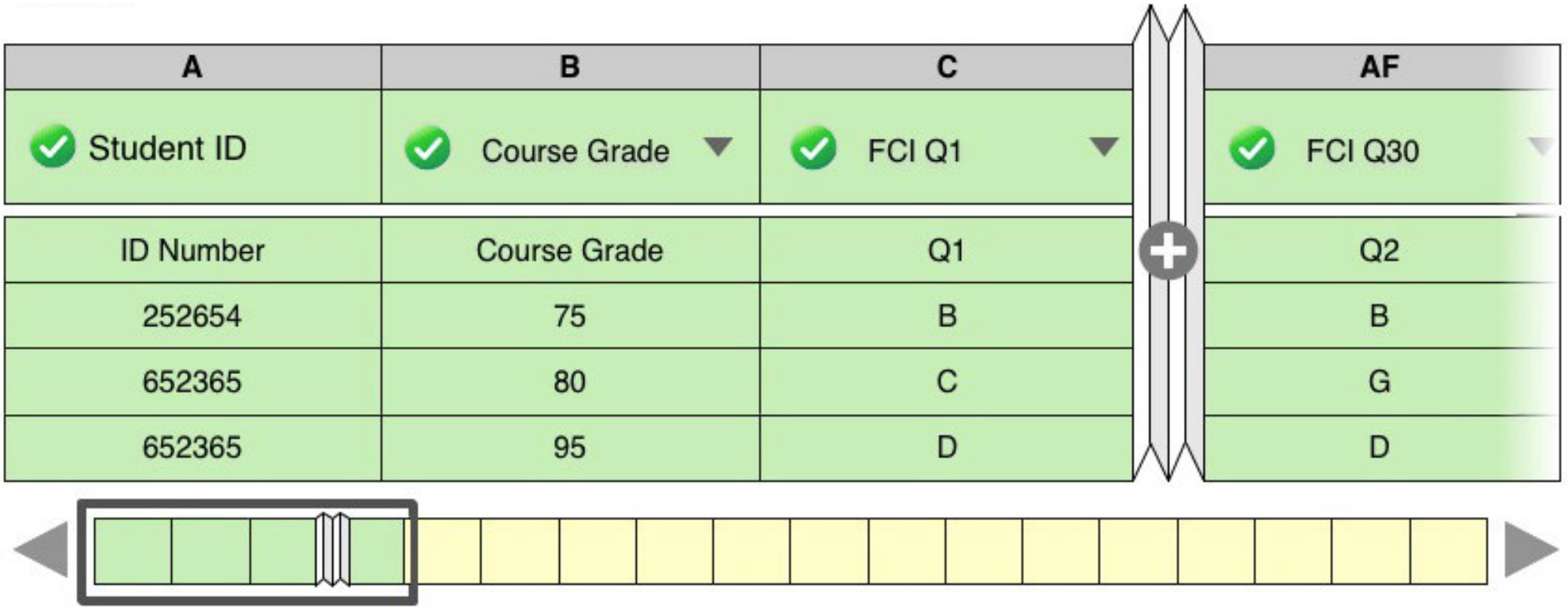


Confirm Auto Guesses in Your File

A	B	C	D
Student ID	Course Grade	FCI Q1	FCI Q2
ID Number	Course Grade	Q1	Q2
252654	75	B	B
652365	80	C	G
652365	95	D	D




It looks like Column B - AD are FCI Questions 2-30
Confirm columns B - AD?
A
B
Student ID
Course Grade
FCI Q1
ID Number
Course Grade
Q1
Q2
252654
75
B
B
652365
80
C
G
652365
95
D
D


A
B
C
AF
Student ID
Course Grade
FCI Q1
FCI Q30
ID Number
Course Grade
Q1
Q2
252654
75
B
B
652365
80
C
G
652365
95
D
D

Add Metadata

Tell us about the file you uploaded

Physics 101.xml: fall2013 section 2

School: University of Central Flatland

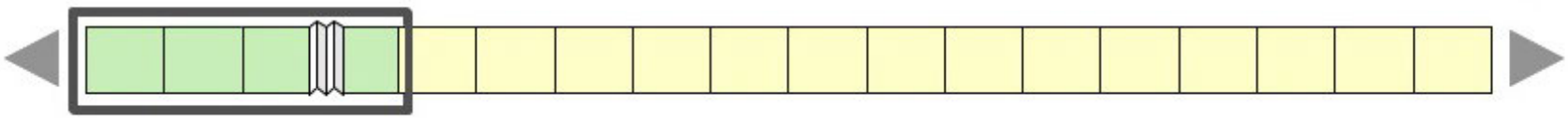
Instructor: Dr. Username

Course: Phys 100

Class: Spring 2013

Assessment: FCI Pre and Post

A	B	C	AF
Student ID	Course Grade	FCI Q1	FCI Q30
ID Number	Course Grade	Q1	Q2
252654	75	B	B
652365	80	C	G
652365	95	D	D



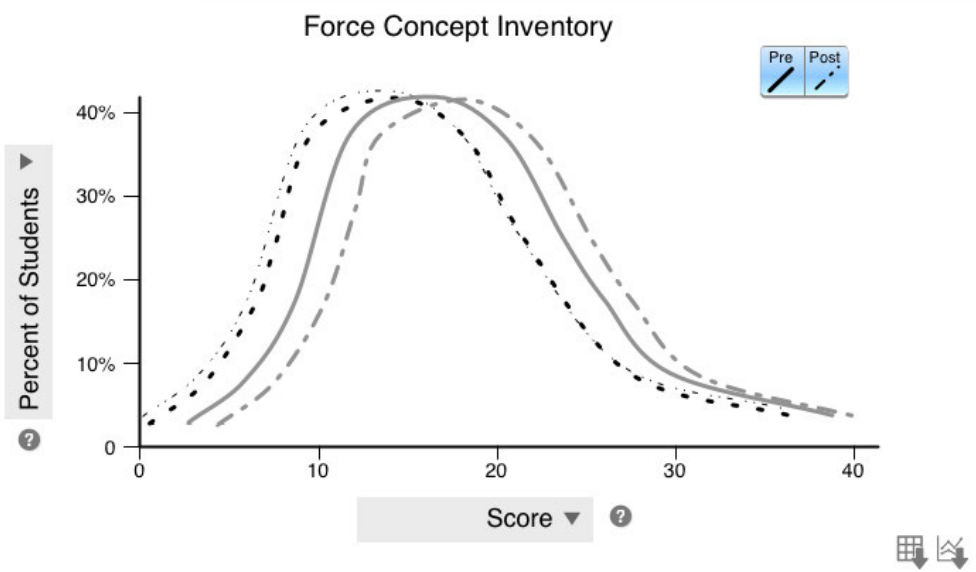
Done

Download Your Report

FCI Results

Dr. Username, University of Central Flatland

Physics 100, Fall 2013



Summary

0.3
Average Gain

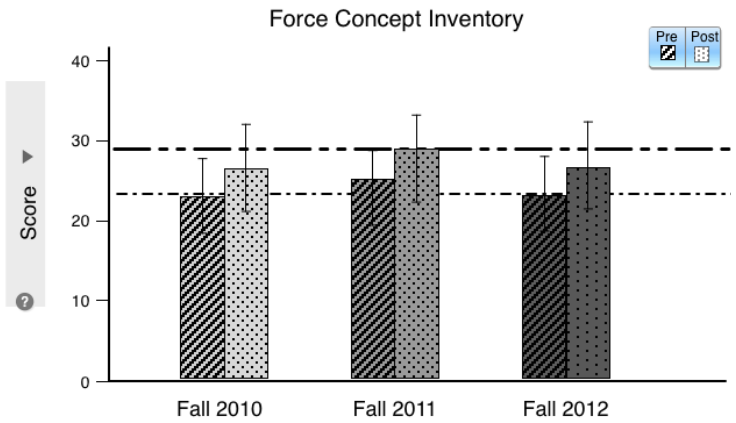
Your students' average normalized gain of 0.3 is similar to the national average but statistically lower than "students like mine". This means that students at similar institutions in similar course have higher gains than your students.

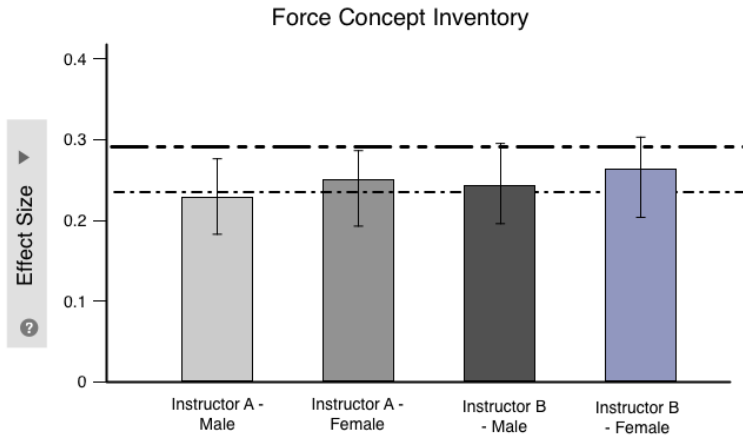
Courses taught using interactive engagement techniques have gains in the range from .18 to .66 with an average of .48. Your normalized gain is in the lower end of this range.

Recommendations

Large courses like yours that are taught using interactive engagement techniques tend to have higher normalized gains. 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 Simulations, Interactive Lecture Demos and Just In Time Teaching.





Homework

Due before Digital Libraries session

(Wed morning)

- Go to physport.org
- Get verified as an educator:
  - Try to access Periscope: physport.org/periscope

    OR
  - Try to download an assessment: physport.org/assessments

Instantaneous for AAPT members,

may take a while otherwise.

PhysPort site content

Now available:

- Resources for research-based teaching
- Resources for research-based assessment
- Video workshops for LAs, TAs, & faculty:
  - Periscope (this morning): physport.org/periscope
  - Virtual New Faculty Workshop: physport.org/nfw

Coming in Fall 2015:

- Redesign and expansion of teaching methods
- Assessment Data Explorer
- Expert Recommendations

PhysPort site content

Long-term goals (not yet funded):

- One-stop shopping
- Community-based database of open-source research-based curricula
- Customized advice: how to interpret your assessment results and/or improve your teaching
- Research on how teaching methods relate to learning gains

PhysPort

Supporting physics teaching with research-based resources

(Formerly known as the PER User's Guide)

Fall 2015: Beta Testing for Assessment Data Explorer

Sign up to be a beta-tester

if you have assessment data for:

FCI, FMCE, BEMA, CSEM, CLASS, MPEX

Email us to learn more:

smckagan@aapt.org

www.physport.org