ILEM - *Integrated Learning Environment for Mechanics*

- Principal Investigator:
  - Dave Pritchard
- Postdocs:
  - Analia Barrantes
  - Carie Cardamone
  - Saif Rayyan
  - Daniel Seaton
  - Raluca Teodorescu
- Collaborators:
  - Gerd Kortemeyer
  - Andrew Pawl
  - Sara Julin

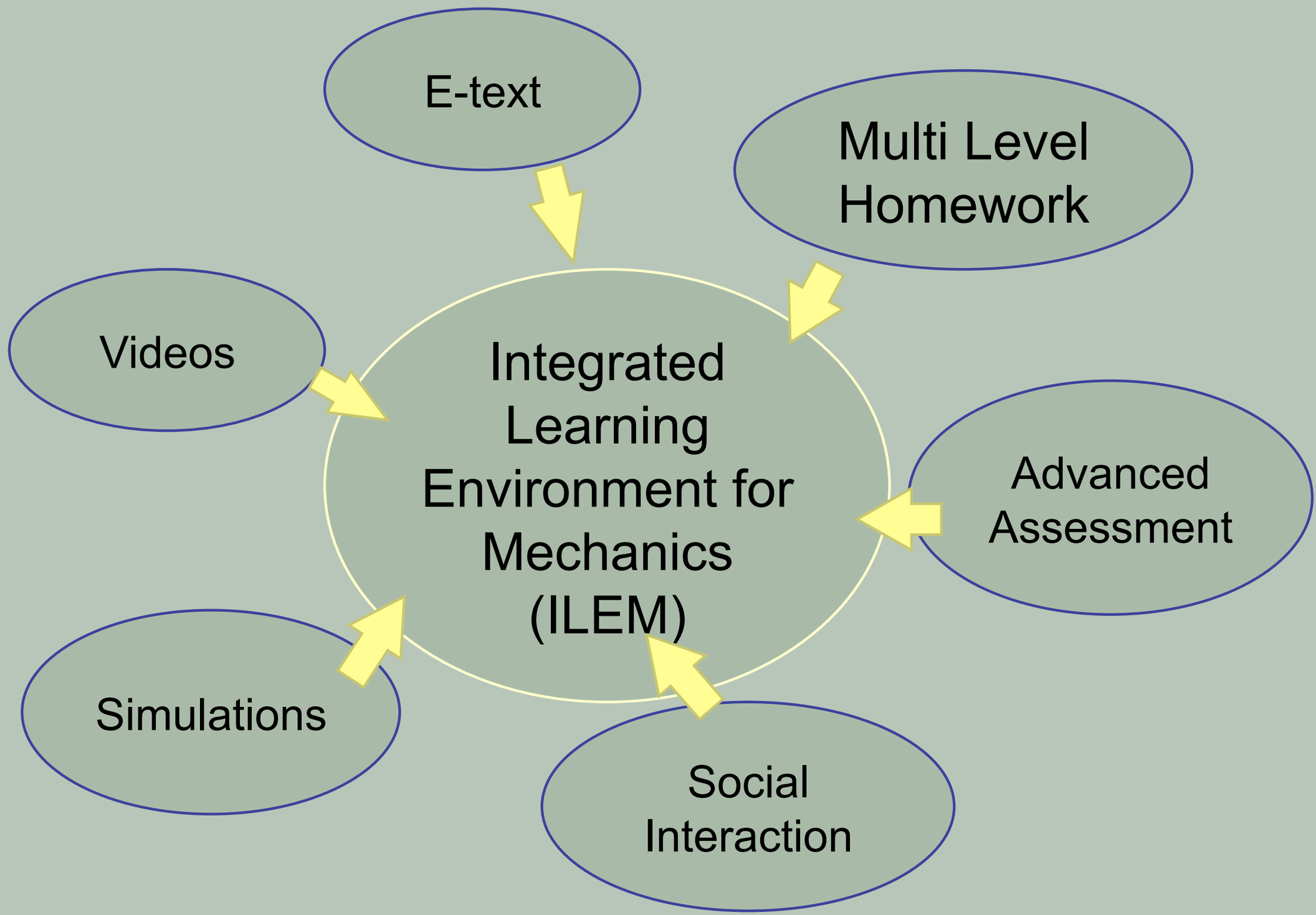
Massachusetts Institute of Technology

Whatcom Community College

University of Wisconsin Platteville

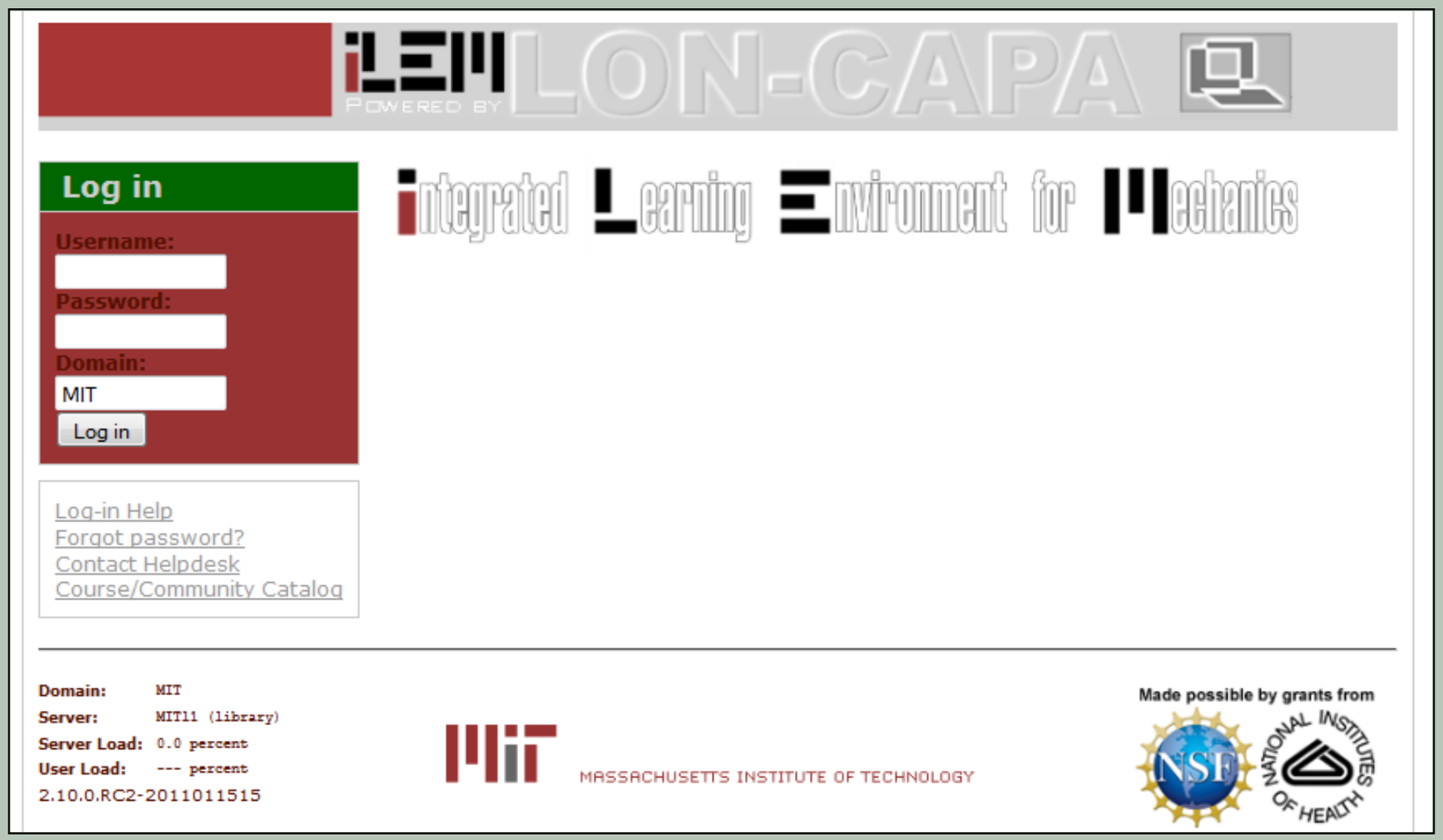
Michigan State University

ILEM


E-text
Multi Level Homework
Videos
Integrated Learning Environment for Mechanics (ILEM)
Advanced Assessment
Simulations
Social Interaction

ILEM @ loncapa.mit.edu

Currently being hosted on LON-CAPA



Teodorescu, R., Pawl, A., Rayyan, S., Barrantes, A. , and Pritchard, D. E.. Physics Education Research Conference 2010 Portland Oregon, AIP Conf. Proc. 1289, 321(2010).

Pedagogy

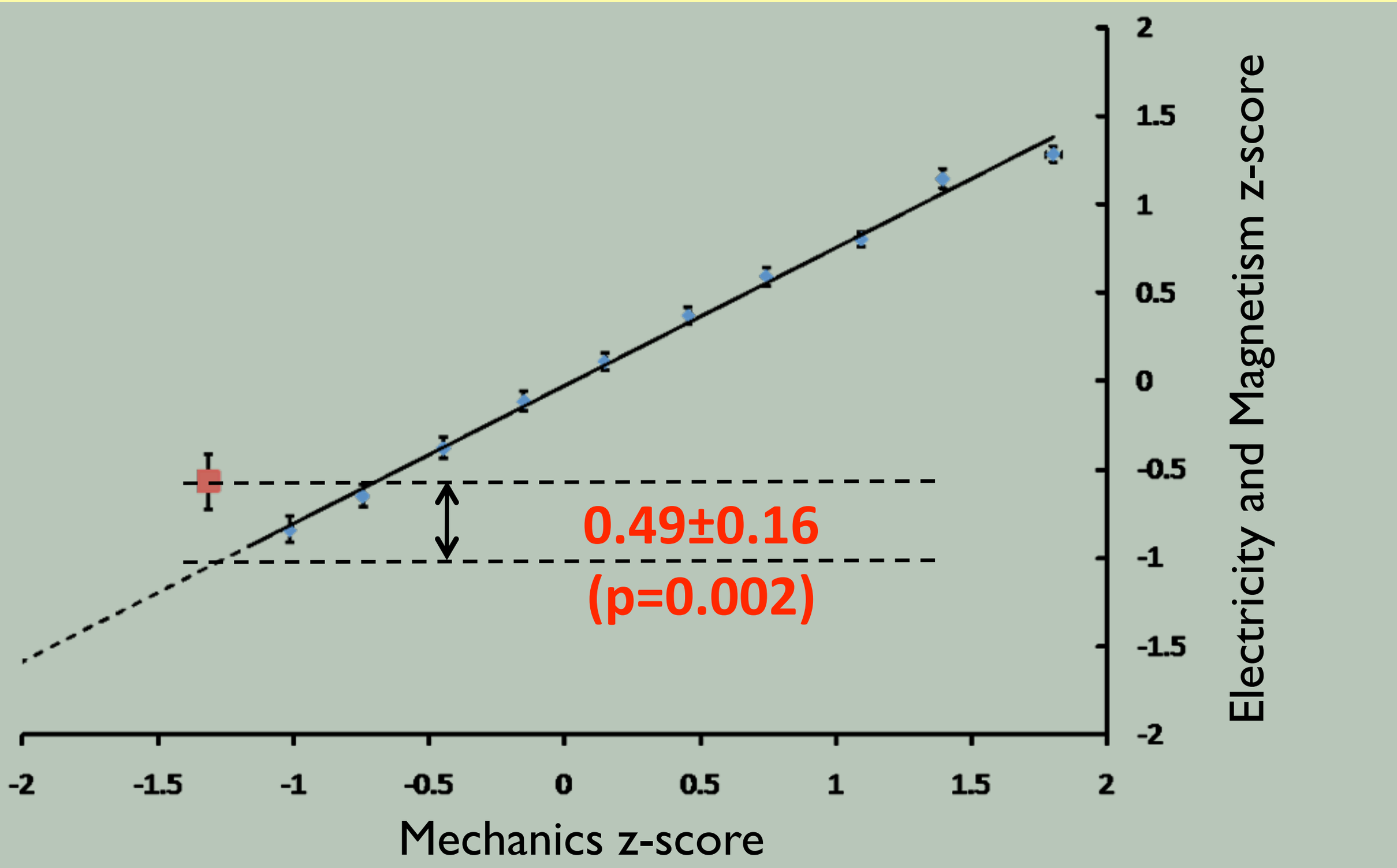
Modeling Applied to Problem Solving (MAPS).

- Students learn how to plan for solving problems in Mechanics.
- Start with specifying the System and the Interactions, and then Choose a Model.
- Collaborative problem solving: groups of 2-3 students working on white boards.
- First implemented in a short ReView for students who failed the fall course

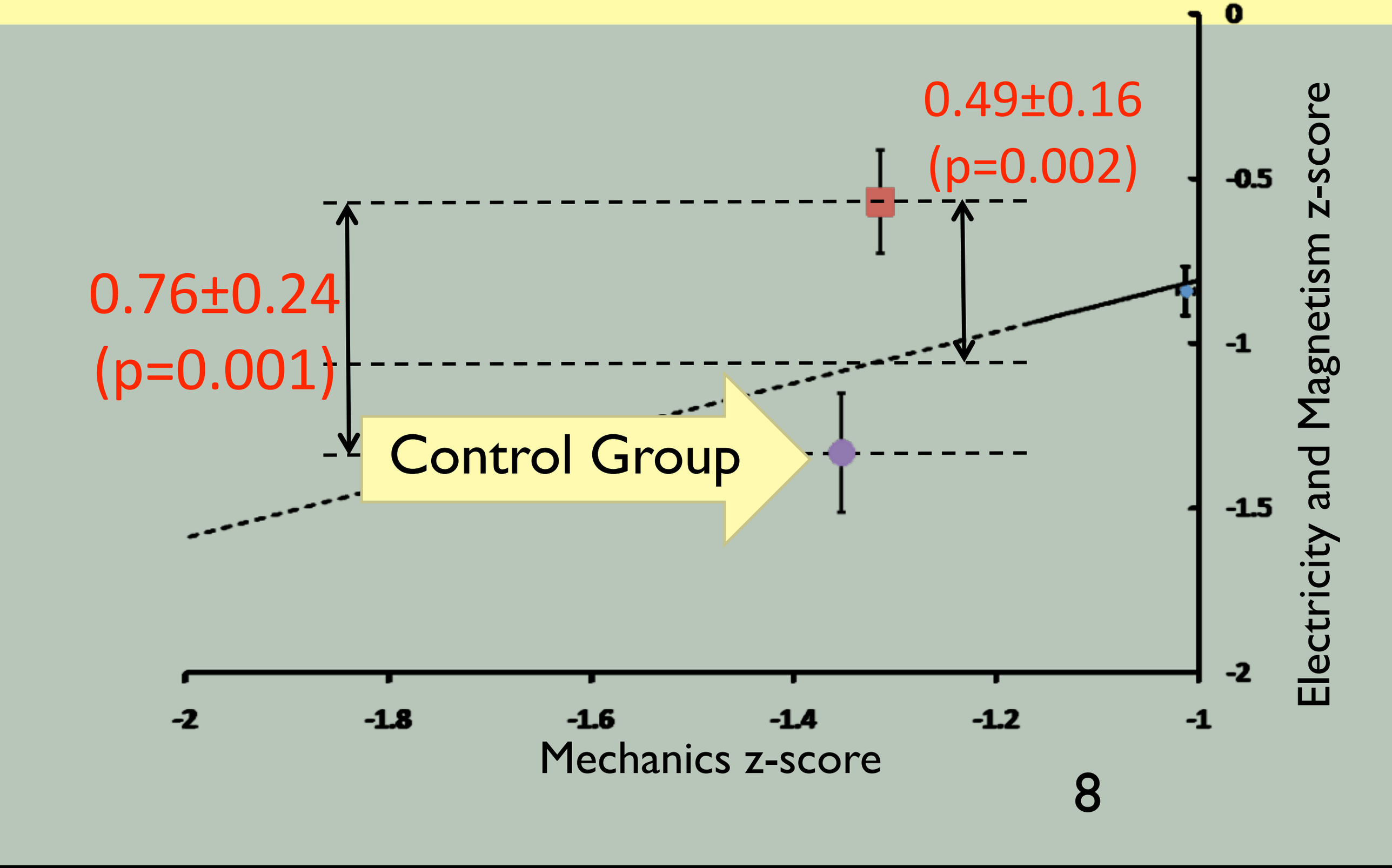
Performance

- More than 1 standard deviations on a final retest.
- Positive shift in Attitudes towards Science and Problem Solving
- About one letter grade improvement in the following EM course

Performance

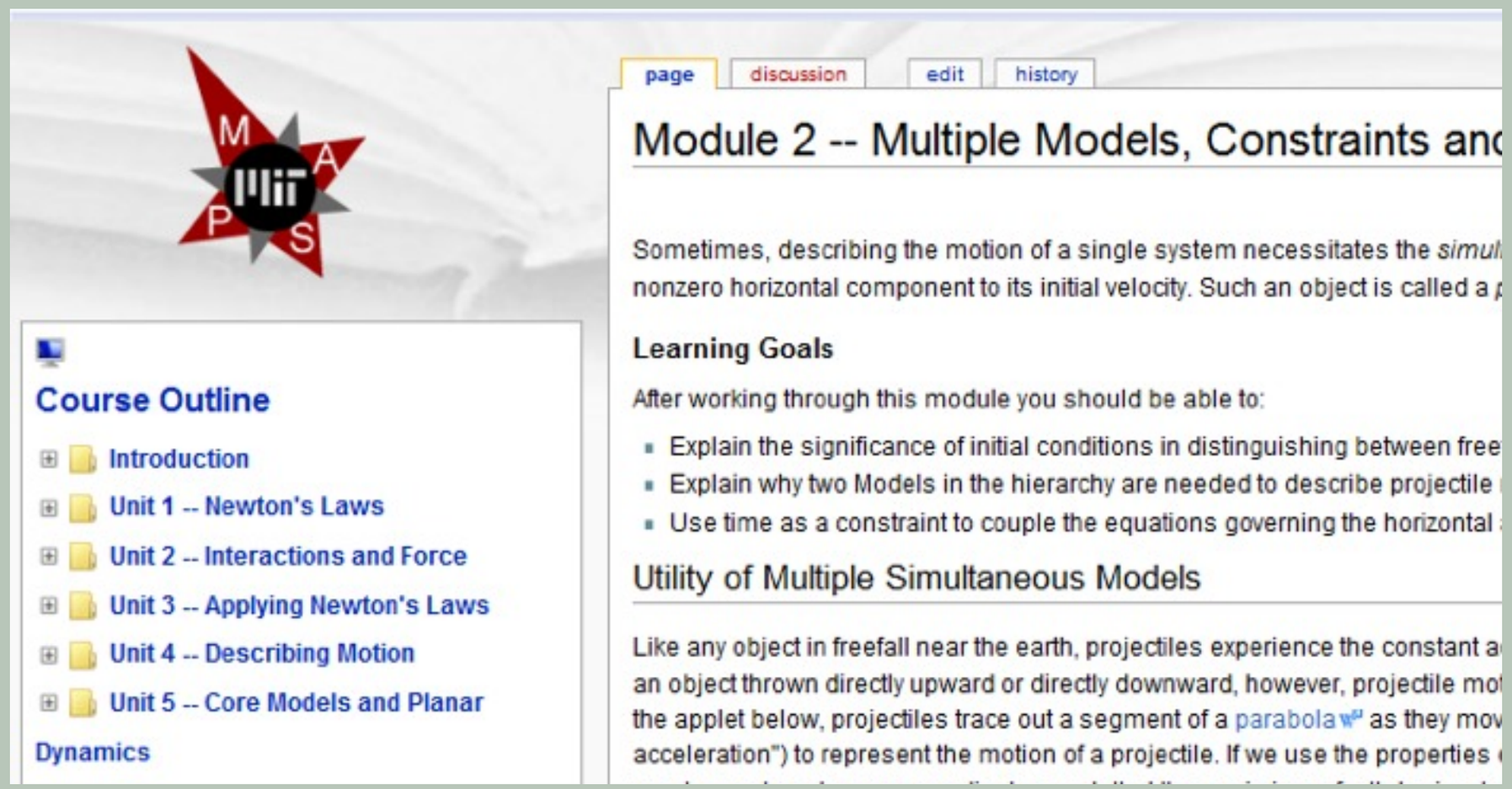


Performance



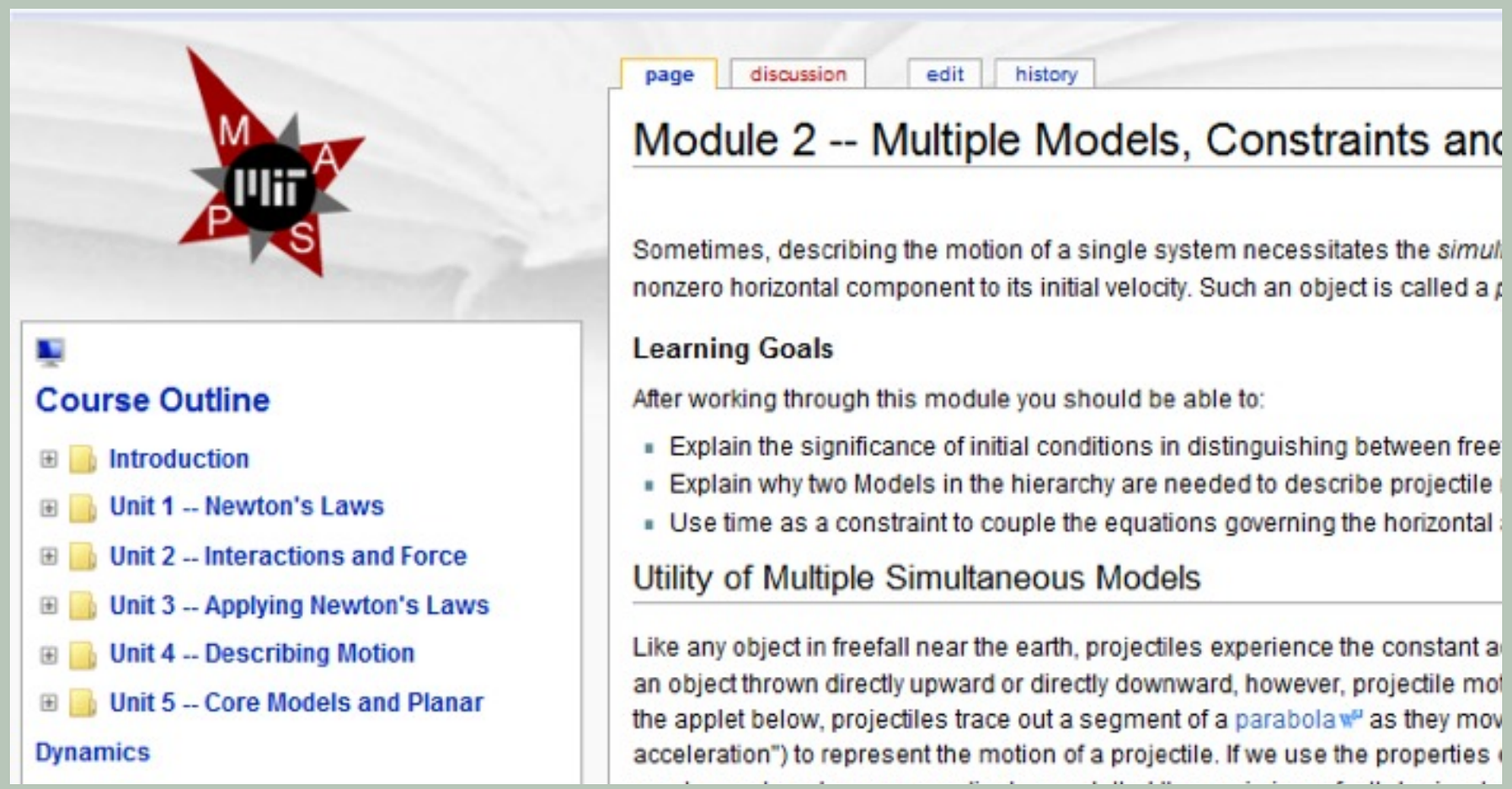
Wiki Text

- http://scripts.mit.edu/~srayyan/PERwiki/
- MAPS instructional material + Research based online resources



Wiki Text

- In LONCAPA:
- /res/MIT/RELATE/MAPS_8011/



Multi Level Homework

Raluca Teodorescu
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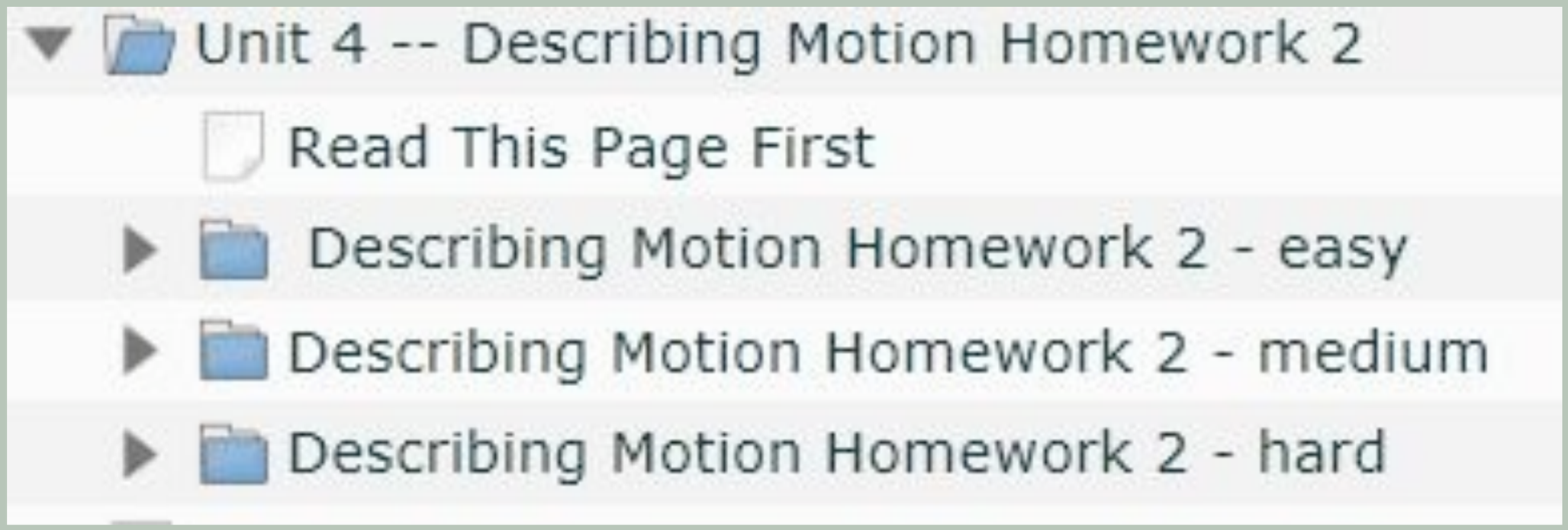
Traditional (55%) and research-based problems (45%)

Complexity	Cognitive Processes	Knowledge	
		Declarative	Procedural
Easy	Recalling, Executing	Vocabulary terms, Facts	Single rules
Medium	Recalling, Executing, Integrating, Representing	Facts, Time sequences	Algorithms
Hard	Recalling, Executing, Integrating, Representing Analyzing errors	Facts, Time sequences, Multiple Principles	Algorithms, Tactics

Multi Level Homework



Choose Your Own Path Homework

Determine your own path:

At what level would you like to begin this homework? (Level 1 = easiest, Level 3 = hardest.)

- Level 1 (Easiest)
- Level 2
- Level 3 (Hardest)

Submit Answer Tries 0/99

Implementation

- Experimental Course at MIT Fall 2010 (10 students)
- Whatcom Community College : Fall 2010 ,Spring 2011 (60 students)
- University of Wisconsin Platteville: Fall 2010, Spring 2011 (120 students)
- MIT Spring 2011 (70 students).
- Workshops at AAPT winter and summer meetings

What is next?

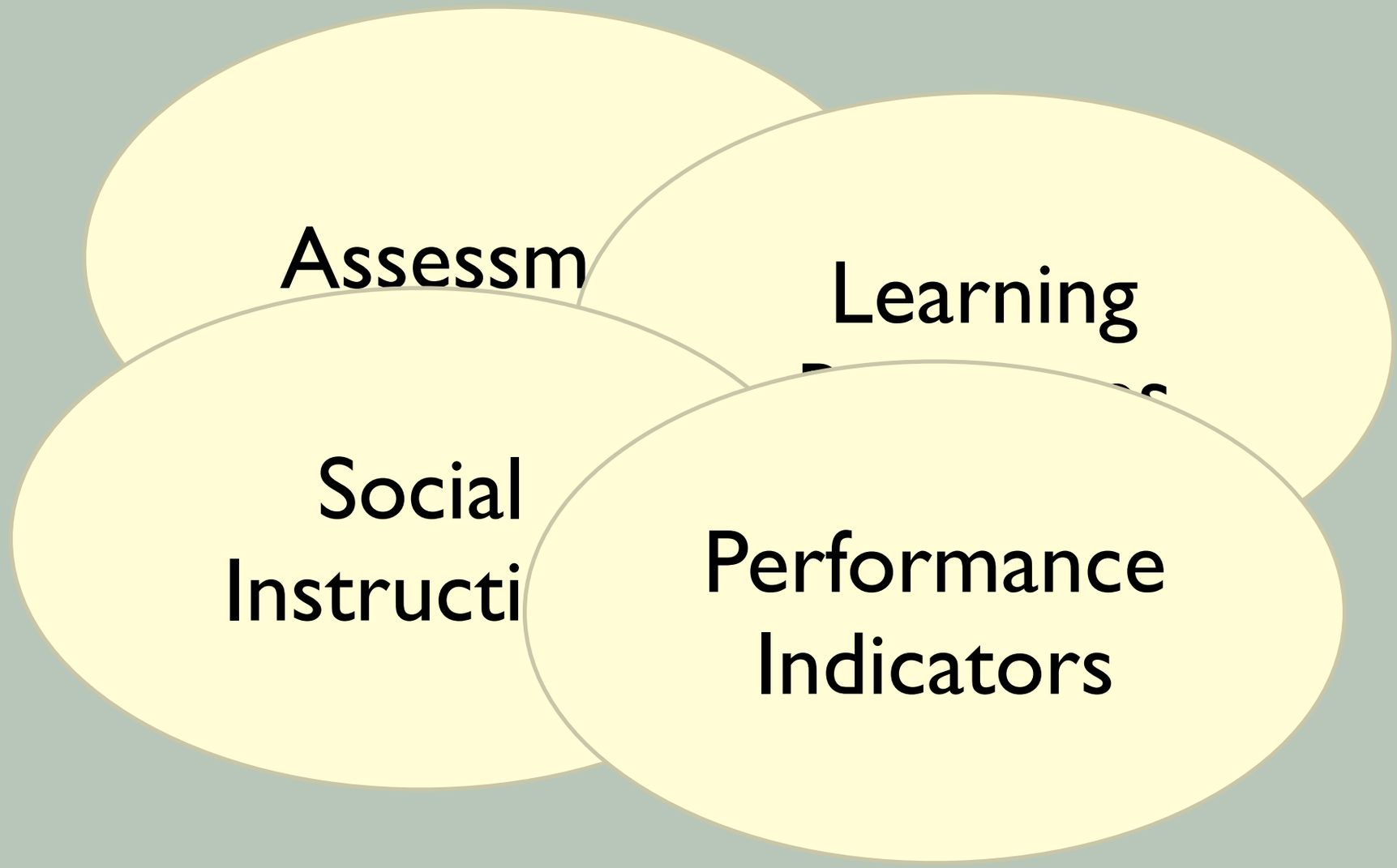
Assessment

Learning Resources

Social Instruction

Performance Indicators

What is next?

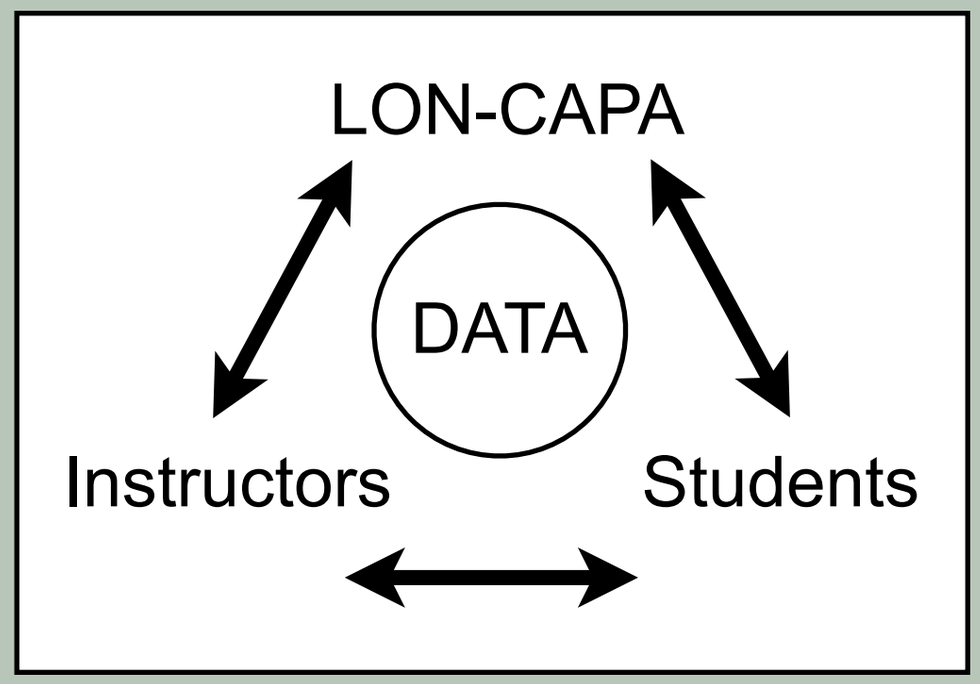

Assessm
Learning
Social
Instructi
Performance
Indicators

Assessment

- Our objective is to define measures of learning; subsequently displaying such measures to students and instructors
- Currently we our formulating the basic research to define useful properties and how they should be displayed

<u>Current Research Efforts</u>

- Analysis of discussion boards
- Item Response Theory
- Time-on-task
- Asset Window



Item Response Theory

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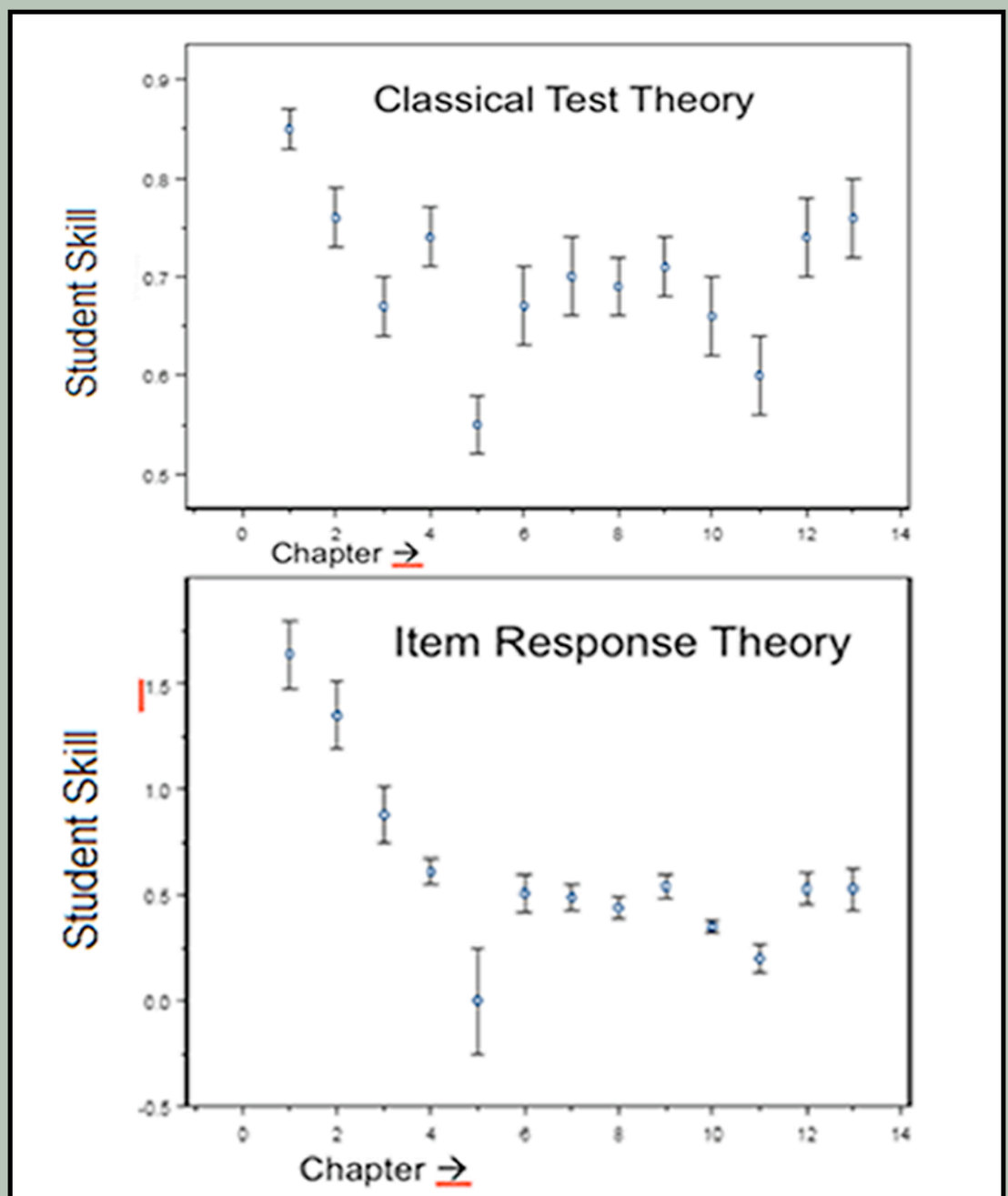
Generalized goal of IRT is to provide discrimination of students and resources within LON-CAPA

- Currently testing IRT methods on data outside LON-CAPA
- Multiple Institutions: MIT, MSU, and UGA
- Figure: comparing classical test and item response theories at estimating student skill for an MIT intro mechanics course



Time-on-task

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Further discrimination of problems and resources through analysis of time

- Course wide measurements
- Student and resource specific measurements
- Would like to understand effects of displaying “time-based” information to students

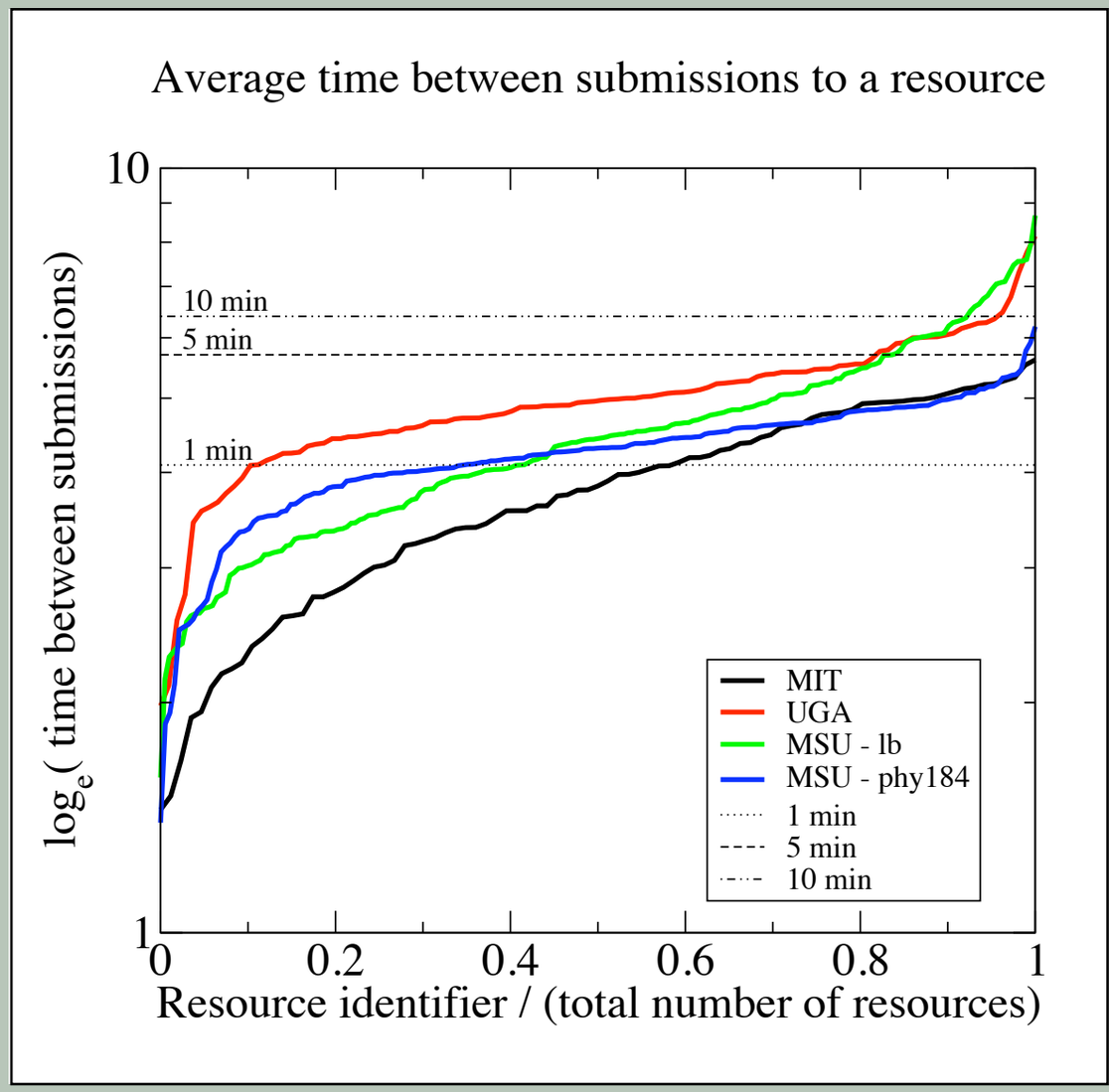

Figure: measuring the time between submissions for all resources from 3 physics courses: MIT, MSU, UGA

Discussion Board Analysis

Spring 2011: Required students to post to discussion throughout the course

- Analysis is underway, with the aim of classifying posts and measuring utility
- Homework where students posted their plans for solving difficult multi-concept problems
- Would like to more greatly facilitate such activities in LON-CAPA

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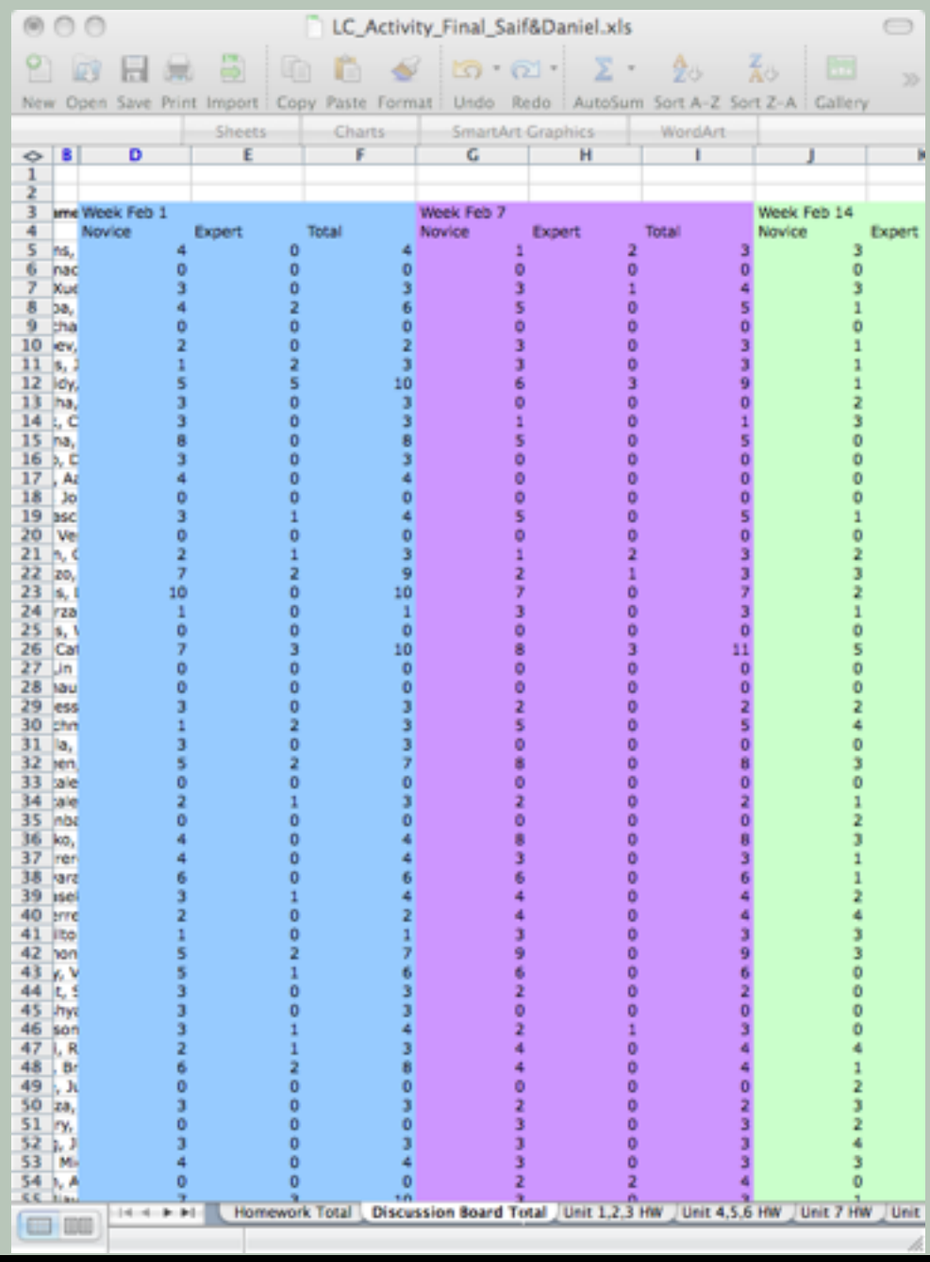

Asset Window

How do we recommend “educational resources” to students based on material and problems?

Saif Rayyan
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- Provides links to other resources: *previously worked problems, videos, online text, etc...*
- Relies heavily on associations and mappings of relationships between content/resources

Many students at MIT take the T (subway) to campus each day. Suppose a 50kg student boards a resting subway car, and departs at a constant acceleration of 4 m/s. If the student remains at rest, with their only contact being their feet with the car floor, calculate the friction force if μ = 0.4. Assume traveling toward campus to be the positive direction.

Submit Answer Tries 0

Asset Window

Resource	Description	Rating
MIT - OCW	Walter Lewin Video - Friction	5.0
Problem	Related Problem	4.0
Wiki text	Course or outstide content	3.0

Asset Window

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Can we apply such a recommender to other elements in LON-CAPA?

- We think yes, e.g., Content pages in our Wiki
- Such a recommender may also facilitate other aspects of LON-CAPA

Conclusions

We are excited to be working within the LON-CAPA community, and we welcome collaborations.

Thank you for your attention!