Surfing the Tsunami

Candace Thille

Global Engineering Deans Council

October 21, 2013

"There's a tsunami coming…I can't tell you how it's going to break, but my goal is to surf it, not just stand there."

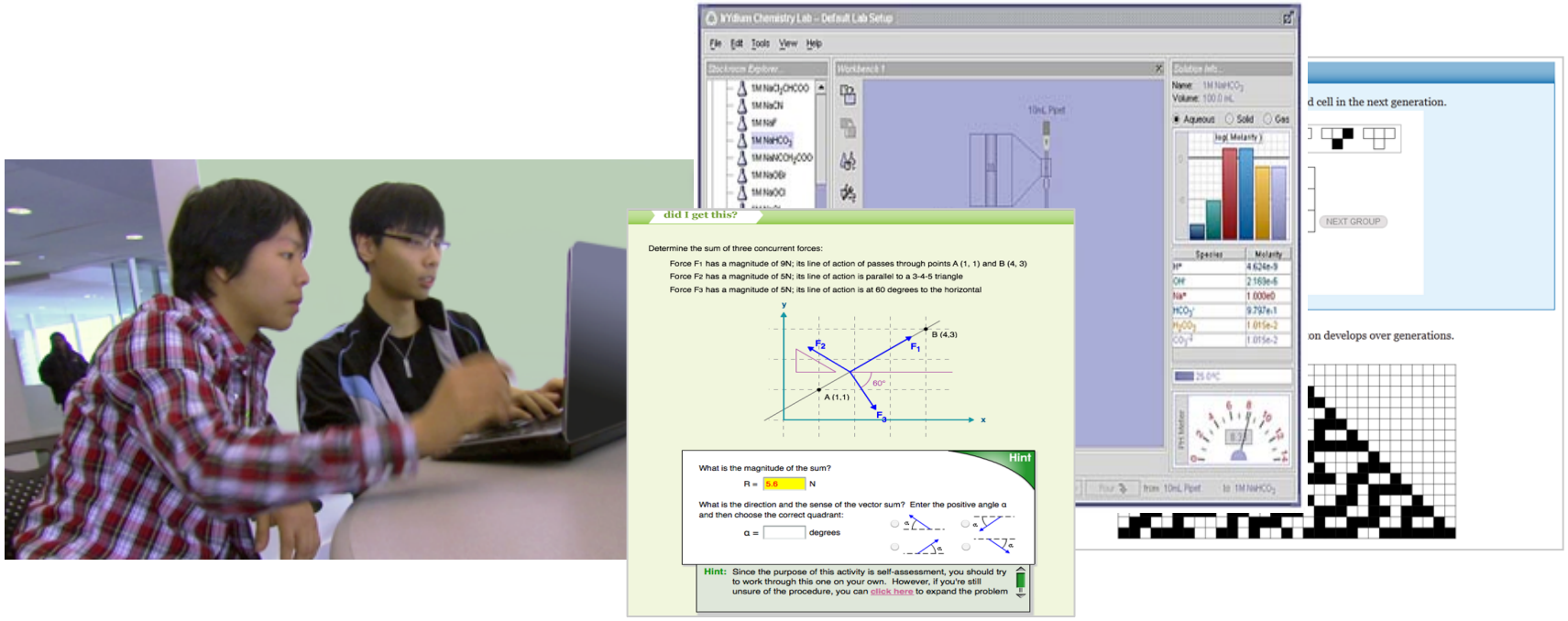
JOHN HENNESSY 2012

"Improvement in post secondary education will require converting teaching from a solo sport to a community-based research activity."

•Herbert Simon 1991

What is the Open Learning Initiative?

Scientifically-based online learning environments based on the **integration** of technology and the science of learning with teaching. OLI is **designed** to simultaneously improve learning and facilitate learning research.



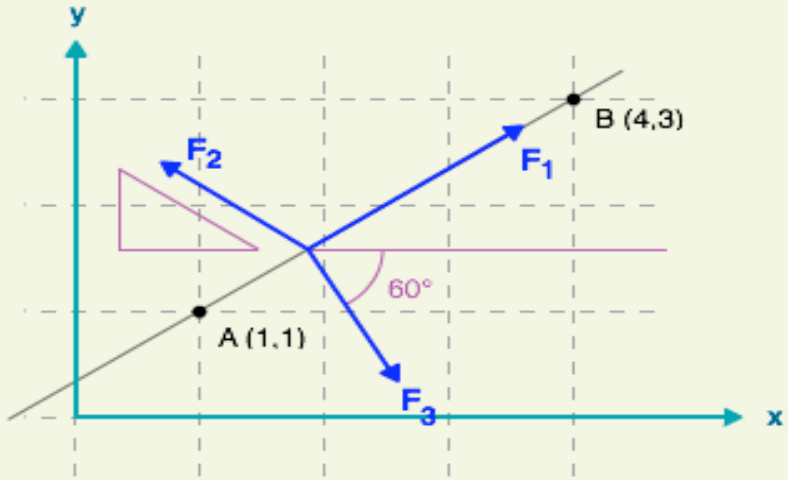
did I get this?

Determine the sum of three concurrent forces:

Force F_1 has a magnitude of 9N; its line of action of passes through points A (1, 1) and B (4, 3)

Force F_2 has a magnitude of 5N; its line of action is parallel to a 3-4-5 triangle

Force F_3 has a magnitude of 5N; its line of action is at 60 degrees to the horizontal



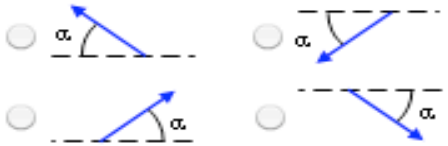
Hint

What is the magnitude of the sum?

R = 5.6 N

What is the direction and the sense of the vector sum? Enter the positive angle α and then choose the correct quadrant:

α = degrees



Hint: Since the purpose of this activity is self-assessment, you should try to work through this one on your own. However, if you're still unsure of the procedure, you can click here to expand the problem

Determine the sum of three concurrent forces:

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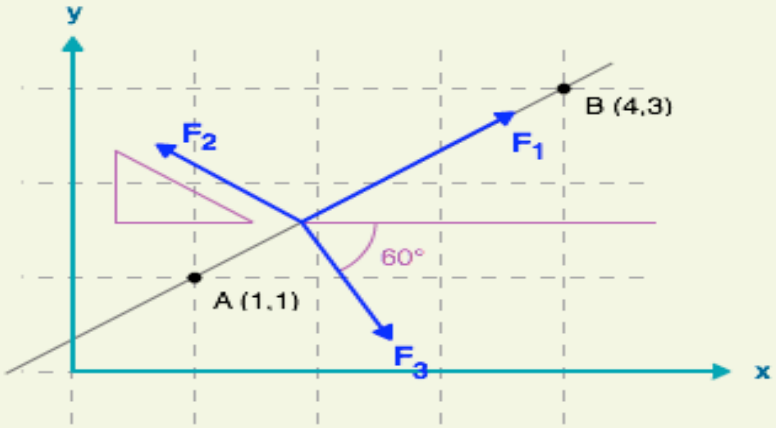

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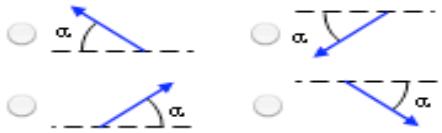

Recall:

Step 1: Resolve each force into components:

F_{1x} =	N	F_{2x} =	N	F_{3x} =	N
F_{1y} =	N	F_{2y} =	N	F_{3y} =	N

Hint: The force has a known magnitude and sense, and its direction can be found because the force acts along the line passing through two known points.

get next hint

Determine the sum of three concurrent forces:

Force F_1 has a magnitude of 9N; its line of action of passes through points A (1, 1) and B (4, 3)

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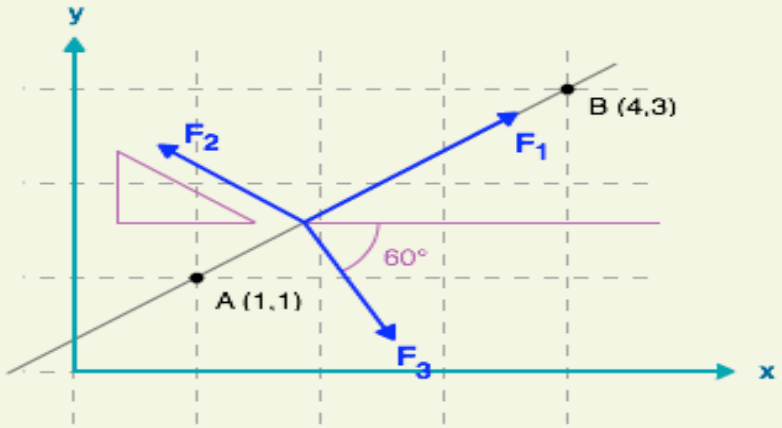

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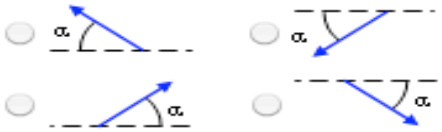

Recall:

Step 1: Resolve each force into components:

F_{1x} =	N	F_{2x} =	N	F_{3x} =	N
F_{1y} =	N	F_{2y} =	N	F_{3y} =	N

Hint: A triangle that describes the direction of the force has horizontal leg of 4 - 1 = 3, vertical leg of 3 - 1 = 2, and hypotenuse of (3^2+2^2)^0.5 = √13 =3.61. The force has magnitude 9 and a

get previous hint get next hint

Determine the sum of three concurrent forces:

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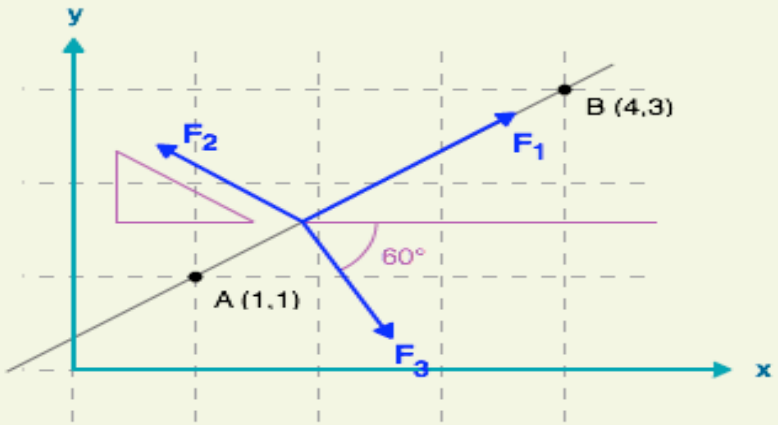


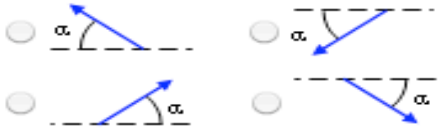
Hint

What is the magnitude of the sum?

R = 5.6 N

What is the direction and the sense of the vector sum? Enter the positive angle α and then choose the correct quadrant:

α = degrees



Recall:

Step 1: Resolve each force into components:

F_{1x} =	N	F_{2x} =	N	F_{3x} =	N
F_{1y} =	N	F_{2y} =	N	F_{3y} =	N

Hint: F_{1x} is $9(3)/\sqrt{13} = 7.49$

get previous hint

Determine the sum of three concurrent forces:

Force F_1 has a magnitude of 9N; its line of action of passes through points A (1, 1) and B (4, 3)

Force F_2 has a magnitude of 5N; its line of action is parallel to a 3-4-5 triangle

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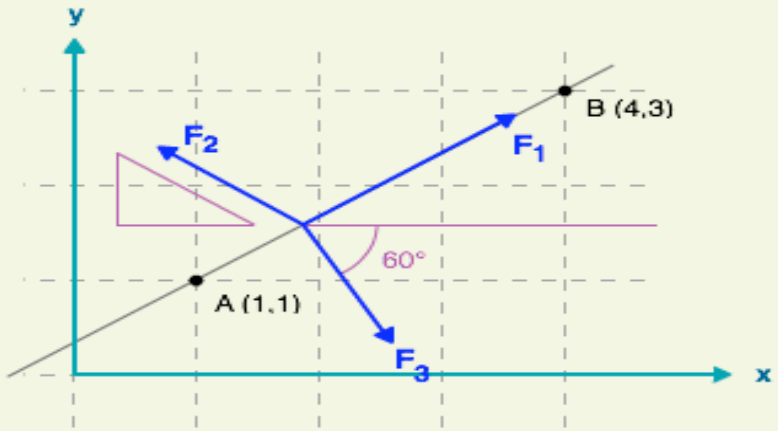


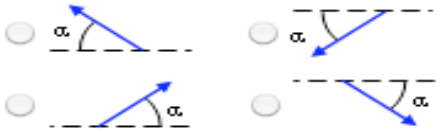
Hint

What is the magnitude of the sum?

R = 5.6 N

What is the direction and the sense of the vector sum? Enter the positive angle α and then choose the correct quadrant:

α = degrees



Recall:

Step 1: Resolve each force into components:

F_{1x} =	7.49 N	F_{2x} =	-4.00 N	F_{3x} =	2.5 N
F_{1y} =	4.99 N	F_{2y} =	3.00 N	F_{3y} =	-4.33 N

✔ Good job! Can you finish the problem on your own now? If not, click here to see another step along with hints.

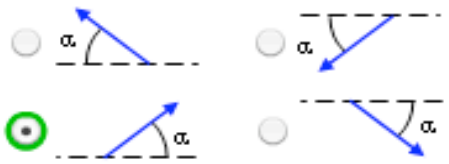
Hint

What is the magnitude of the sum?

R = 5.91 N

What is the direction and the sense of the vector sum? Enter the positive angle α and then choose the correct quadrant:

α = 39.1 degrees



Recall:

Step 1: Resolve each force into components:

F1x =	7.49 N	F2x =	-6.40 N	F3x =	3.5 N
F1y =	4.99 N	F2y =	4.80 N	F3y =	-6.06 N

Step 2: Find the components of the sum by summing components of the forces:

Rx = ΣFx = 4.59 N Ry = ΣFy = 3.73 N

Step 3: Find the magnitude of the sum $R = \sqrt{R_x^2 + R_y^2}$

(enter your answer at the top)

Step 4: Find the direction and sense of the vector sum. $\alpha = \tan^{-1}\frac{|R_y|}{|R_x|}$

(enter your answer at the top)

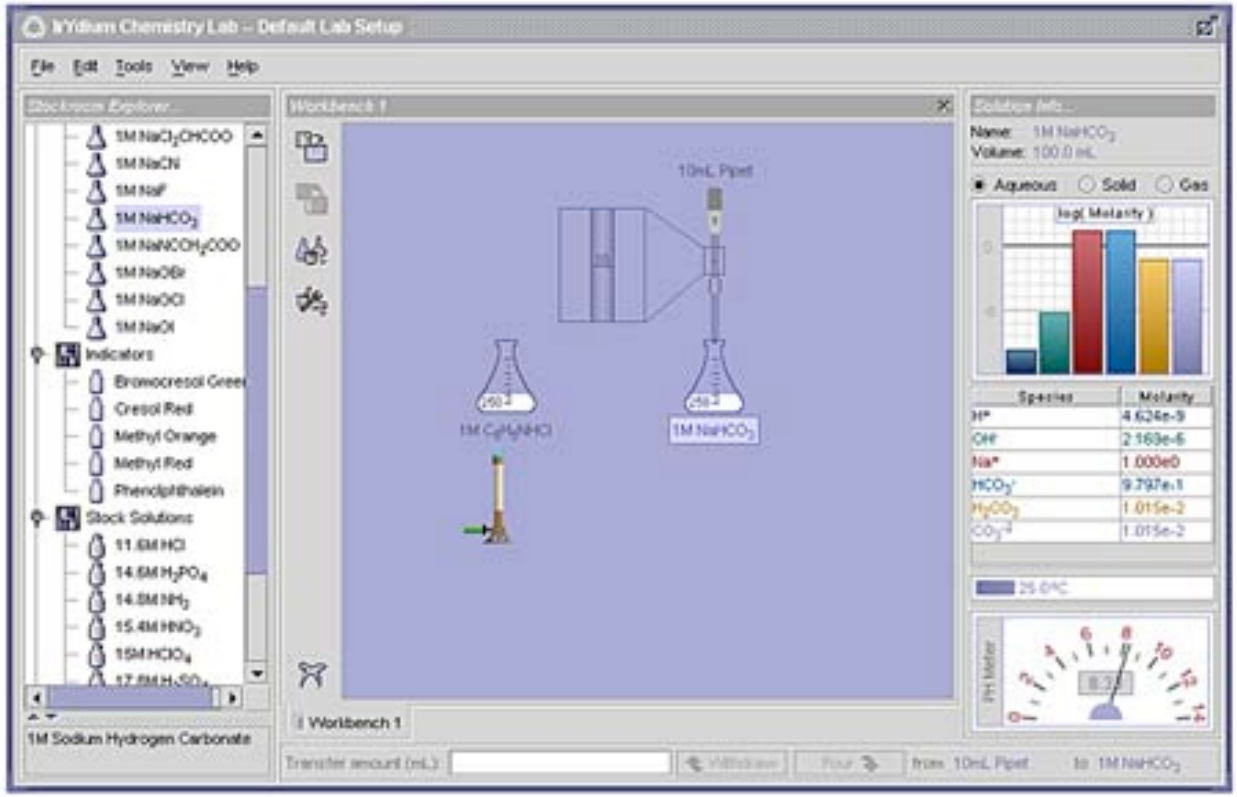
✓ Good job! Now click here to try one on your own, without us walking you through the individual steps.

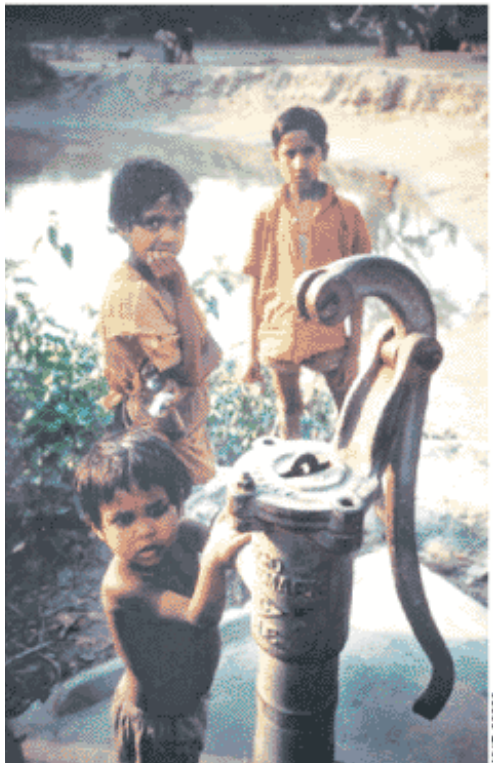
What is a Cognitive Tutor?

A computerized learning environment whose design is based on cognitive principles and whose interaction with students is based on that of a (human) tutor—i.e., making comments when the student errs, answering questions about what to do next, and maintaining a low profile when the student is performing well.

Principles Derived from Learning Science:

Practice Synthesizing and Applying Skills & Knowledge

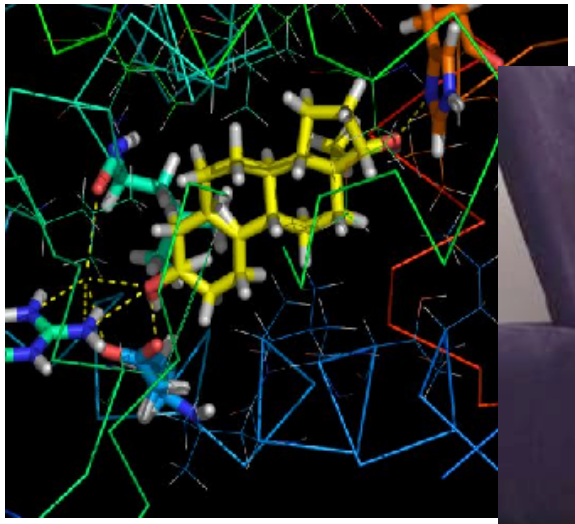




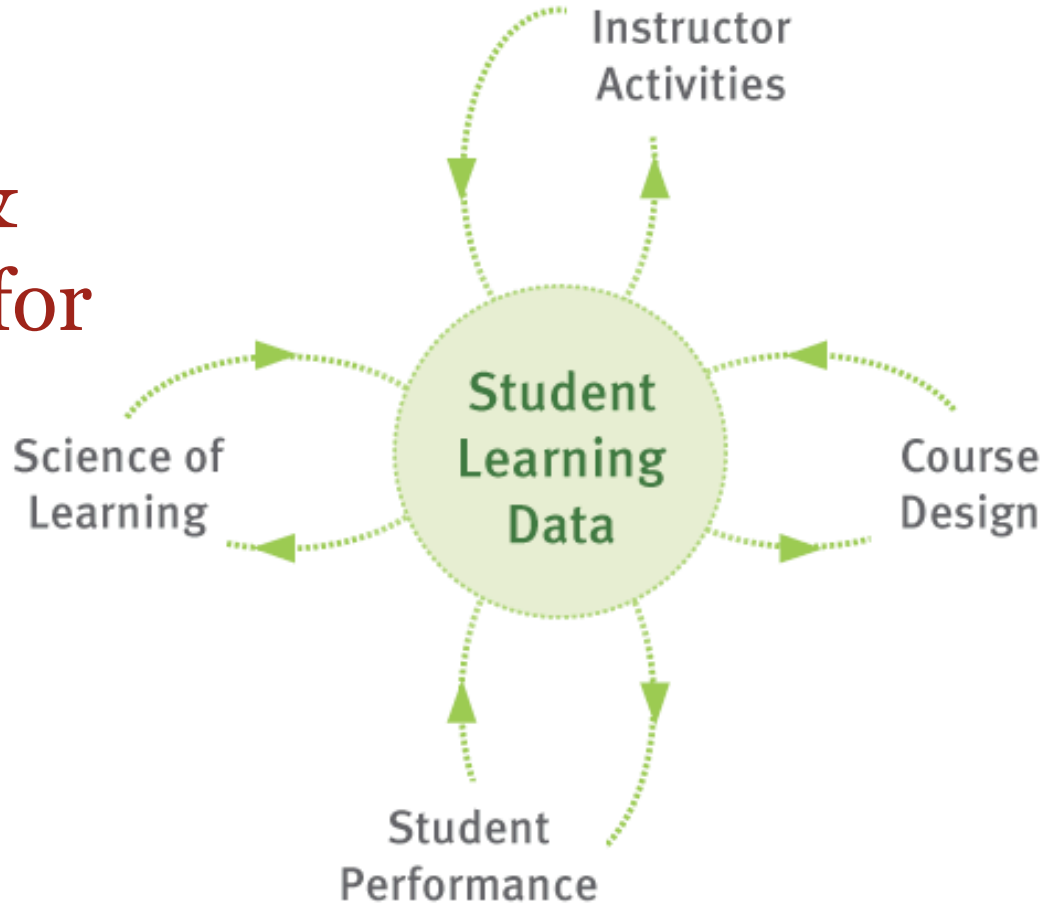
Module 3 / Arsenic in Bangladesh

To show how stoichiometry is used in practice, much of this course is set in the context of arsenic contamination in the ground water of Bangladesh. The following video introduces this context and why stoichiometry plays an important role in this environmental problem.

What Are the Affordances of the Technology?



The "Killer App" Data Collection & Feedback Loops for Continuous Improvement



Module 1

Examining Distributions

ESTIMATED LEARNING LEVEL

Learning Objectives

Summarize and describe the distribution of a categorical variable in context.
[» Show Details...]

Generate and interpret several different graphical displays of the distribution of a quantitative variable (histogram, stemplot, boxplot).
[» Show Details...]

Summarize and describe the distribution of a quantitative variable in context: a) describe the overall pattern, b) describe striking deviations from the pattern.
[» Show Details...]

Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.
[» Show Details...]

Compare and contrast distributions (of quantitative data) from two or more groups, and produce a brief summary, interpreting your findings in context.
[» Show Details...]

Apply the standard deviation rule to the special case of distributions having the "normal" shape.
[» Show Details...]

Class Participation

39 of 40 students participated

48% of 43 activities started on average

» View Participation in Module by Student

Open-ended Responses

» One Categorical Variable > Learn By Doing [11]

» Histogram > Learn By Doing [4]

» My Response: About Stemplots [9]

» Measures of Center > Learn By Doing [12]

Show All (14 more)

Checkpoints and Quizzes

» Checkpoint: Examining Distributions Checkpoint 1 [38]

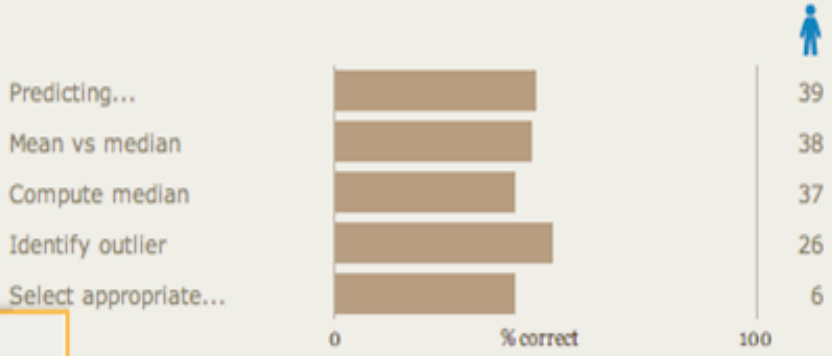
» Checkpoint: Examining Distributions Checkpoint 2 [36]

Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.

[» Hide Details...]

Estimated Learning *by Student*

Class Accuracy by *Sub-Objective*



Students with Moderate Estimated Learning

	ACTIVITIES ATTEMPTED
Student names removed	7
	8
	10
	8
	9
	8
	9
	8
	10
	8
	9
	9

Contact these students

...ve data) from two or more groups, and ...ngs in context.

...ase of distributions having the "normal"

Class Parti...

39 of 40 st...

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...earn By Doing [11]

[4]

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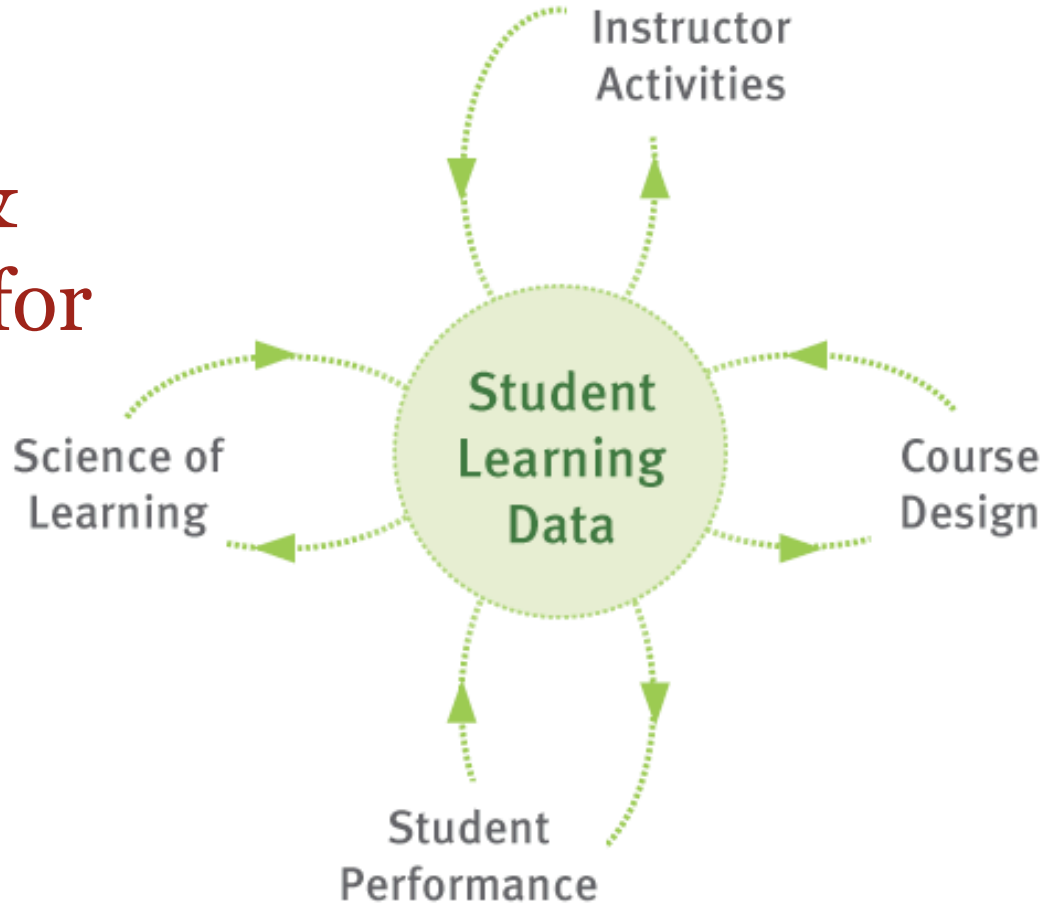
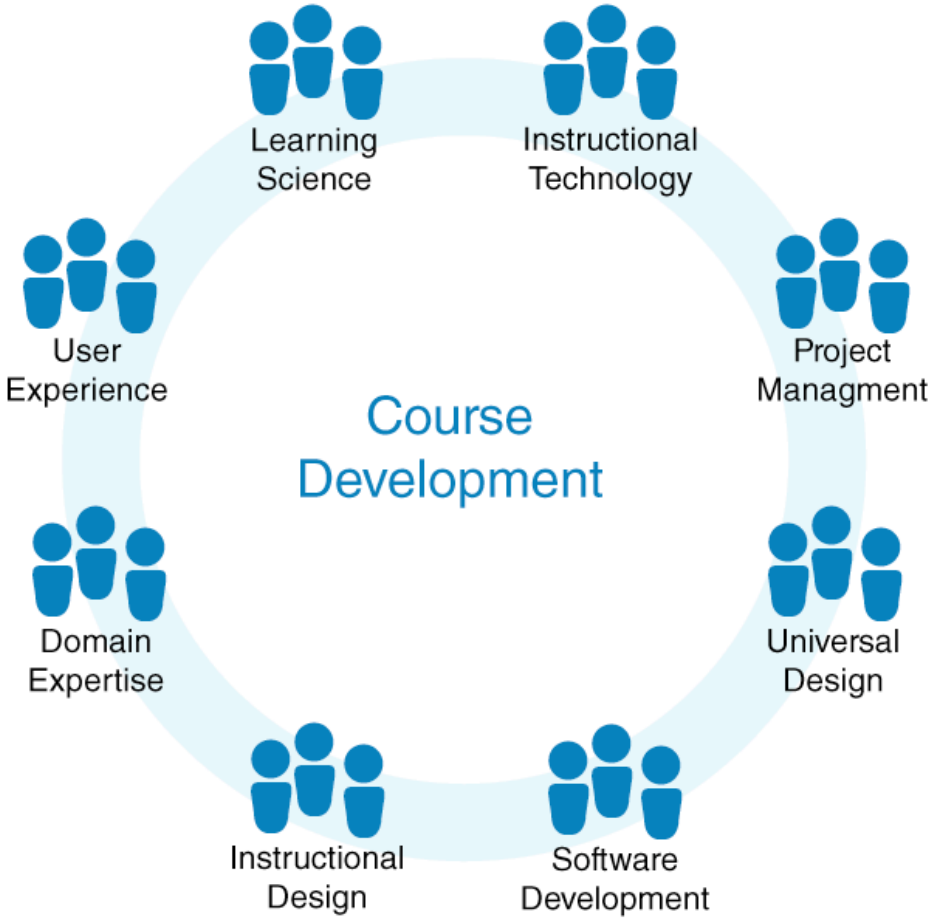


Team-based design and development



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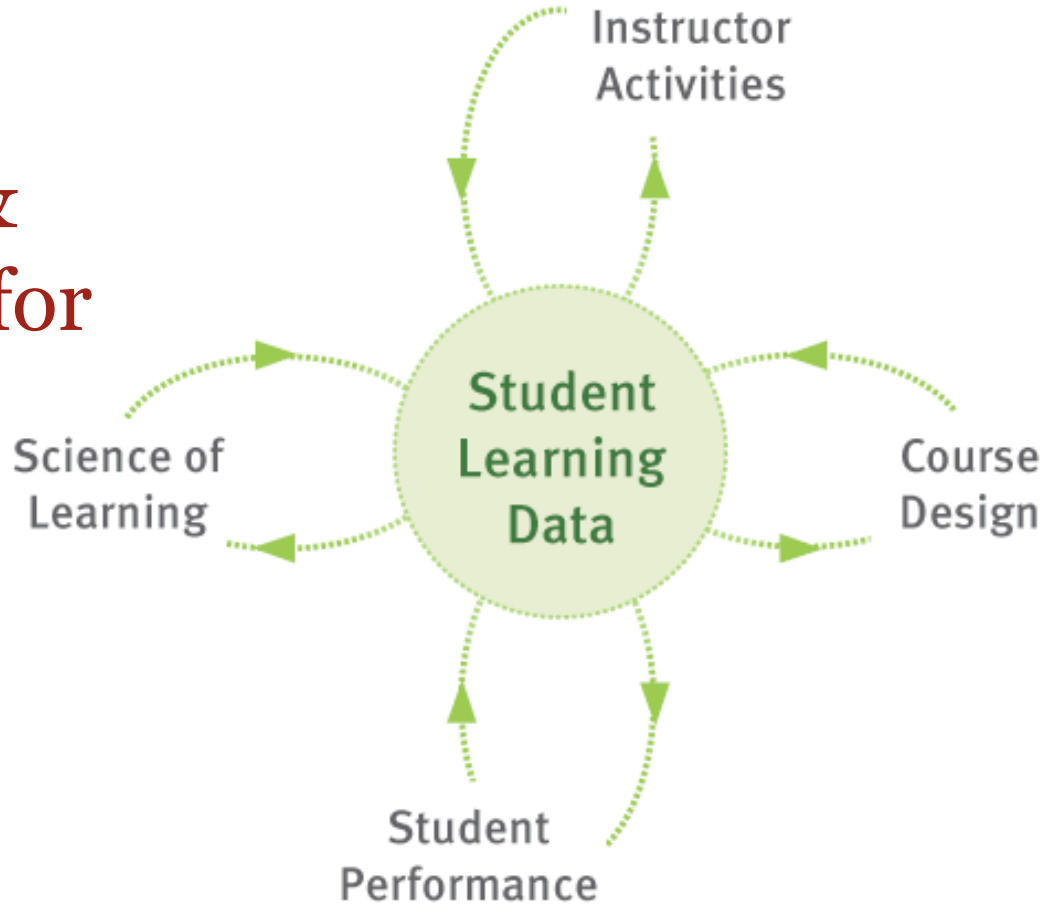
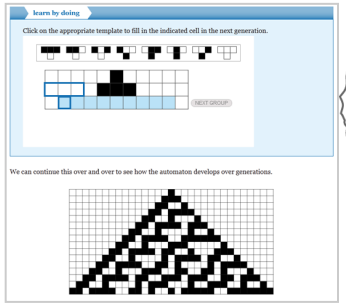


LearnLab:
Transforming Education Research

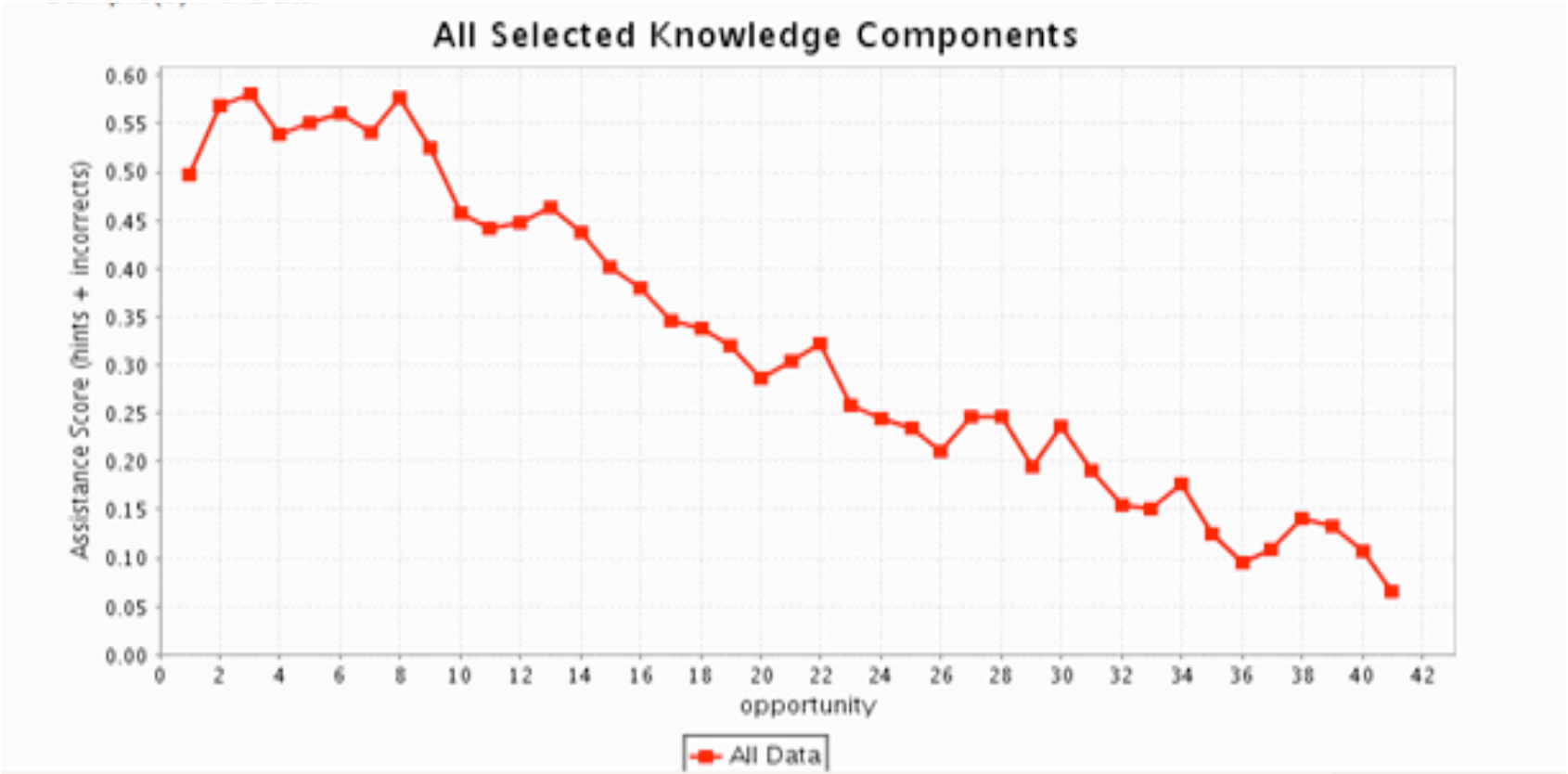


LearnLab
Pittsburgh Science of Learning Center

Ed tech + wide use = "Basic research *at scale*"

- NSF Science of Learning Center
- 10 years, ~$50 million
- Tech enhanced courses, assessment, & research
- School cooperation for data collection

Learning Curve Analysis



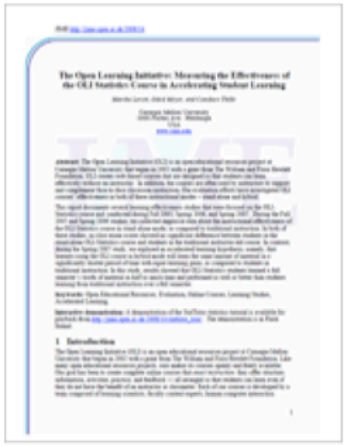
DataShop: Pittsburgh Science of Learning Center

OLI Review:

- Apply learning science research and scientific method to course development, implementation and evaluation.
- Develop interactive learning environments collaboratively
- Feedback loops for continuous improvement.
- Communities of use, evaluation and improvement.

What Difference Does it Make?

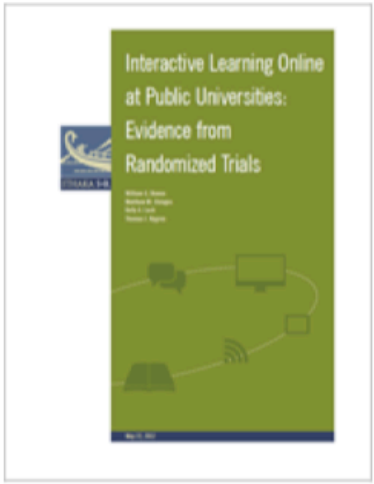
Results



OLI STUDY ON ACCELERATING STUDENT LEARNING WITH OLI STATISTICS

Lovett, M., Meyer, O., & Thille, C. (2008). The Open Learning Initiative: Measuring the effectiveness of the OLI statistics course in accelerating student learning. Journal of Interactive Media in Education.

This study, conducted at Carnegie Mellon University, shows that students using the OLI statistics course at Carnegie Mellon achieved the same or better learning outcomes as students in the traditional course in **half the time**.



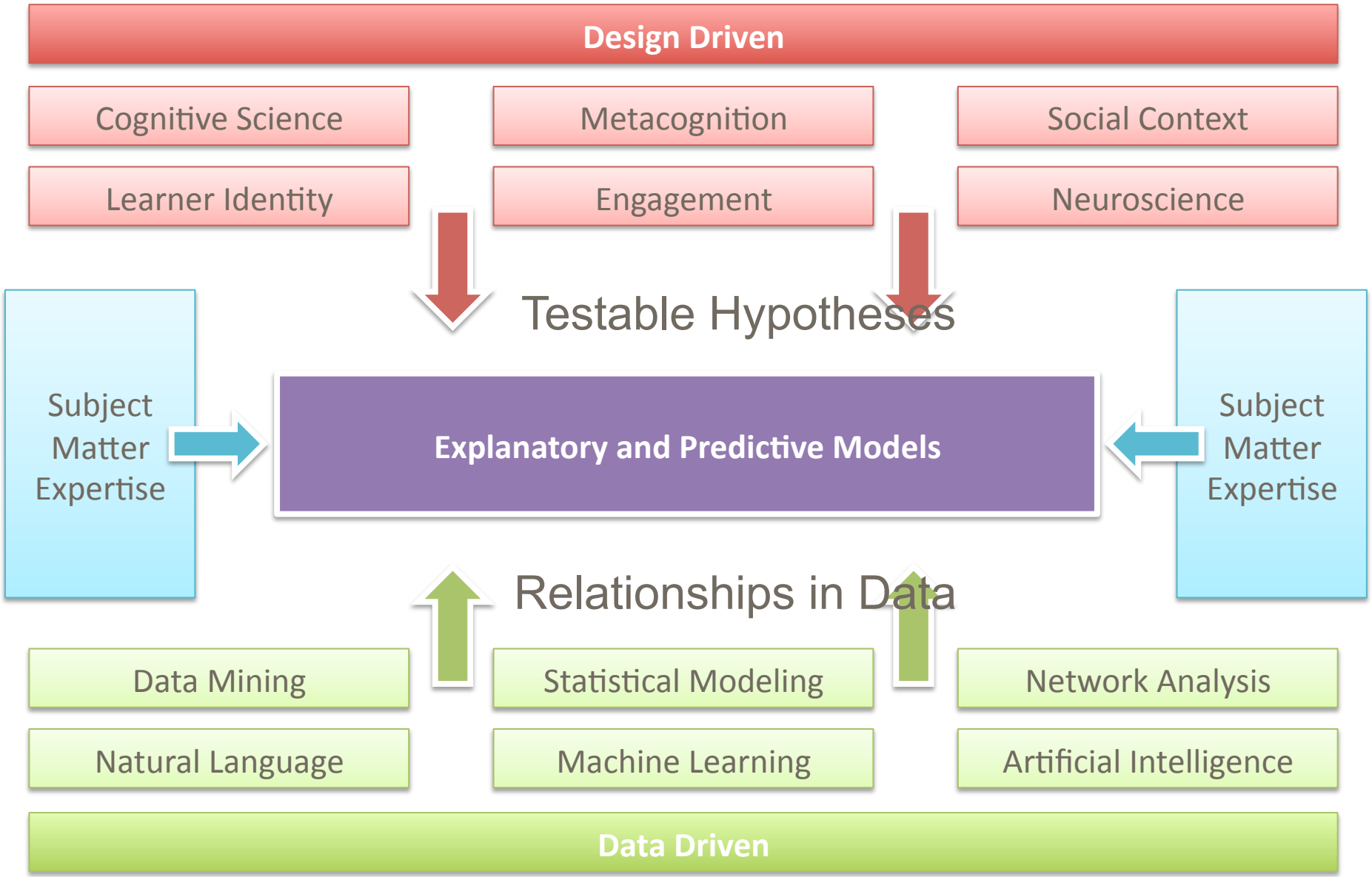
INDEPENDANT TRIAL OF THE OLI STATISTICS COURSE

Bowen, W.G., Chingos, M.M., Lack, K.L., & Nygren, T.I. (2012). Interactive Learning Online at Public Universities: Evidence from Randomized Trials. ITHAKA.

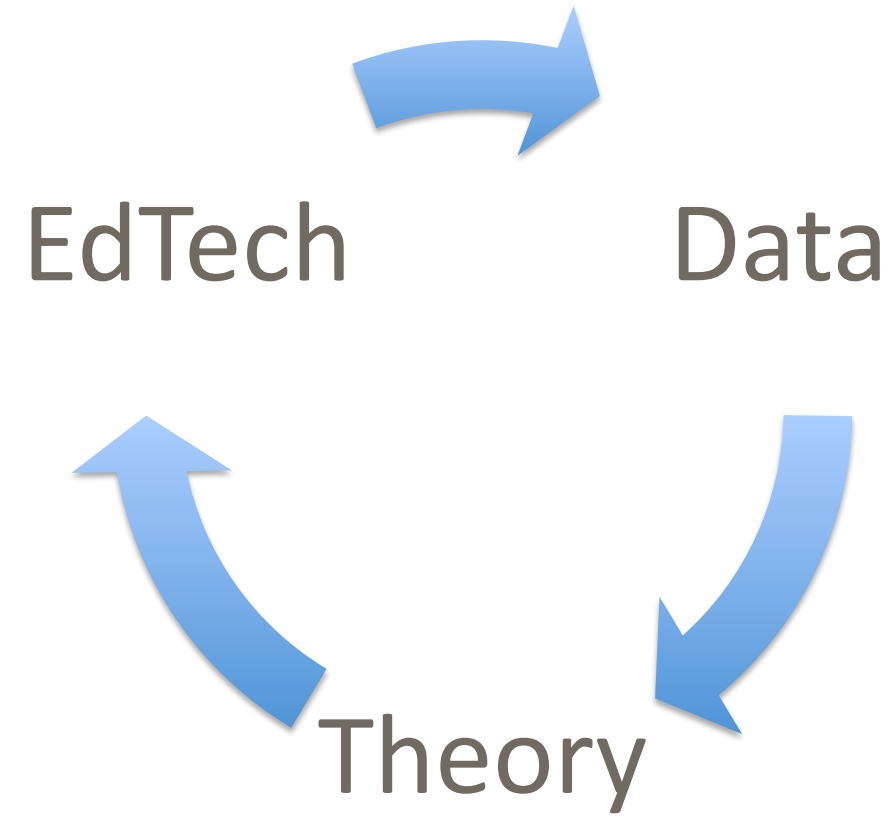
The results of this study are remarkable; they show comparable learning outcomes for this basic course, with a promise of cost savings and productivity gains over time.
Deanna Marcum
Managing Director, Ithaka S+R

OLI v2.0


OpenEdX
opening new possibilities
22-Aug-2013
Stanford University


Design Driven
Cognitive Science
Metacognition
Social Context
Learner Identity
Engagement
Neuroscience
Testable Hypotheses
Subject Matter Expertise
Explanatory and Predictive Models
Subject Matter Expertise
Relationships in Data
Data Mining
Statistical Modeling
Network Analysis
Natural Language
Machine Learning
Artificial Intelligence
Data Driven

Strategy for Educational Improvement



"Without a complete revolution…in our approach to teaching…we cannot go beyond (current levels) of productivity" (Baumol, 1967).

Our message:
Such a revolution is possible.

Our question:
Who will lead it?

THE WILLIAM AND FLORA HEWLETT FOUNDATION

BILL & MELINDA GATES foundation

Lumina FOUNDATION

spencer

THE KRESGE FOUNDATION

The Walter S. Johnson Foundation

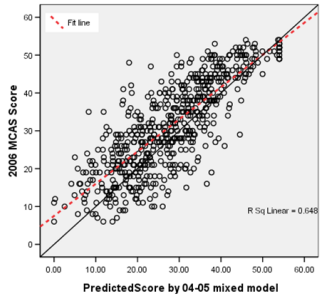
- LearnLab is funded by The National Science Foundation award number SBE-0836012.

NSF

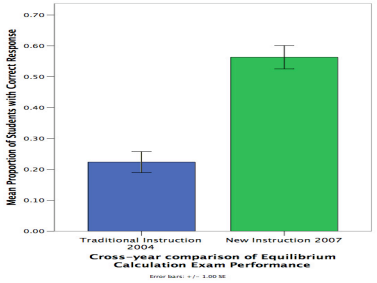
- Extra Slides

Better Science & Technology …

Improves Assessment



Increases Outcomes

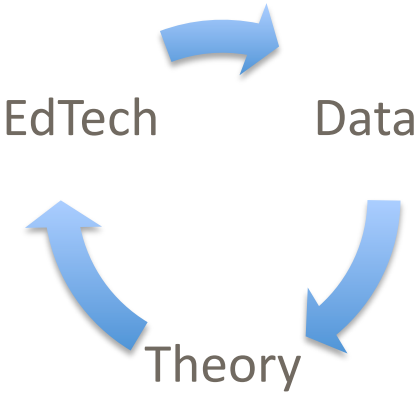


Accelerates Learning

> 100 hours
~3% gain

< 50 hours
~18% gain

Produces A Virtuous Cycle



Learning Science & Engineering

20th Century	21st Century
Intuitive Design	Evidence Based Design
Isolated Development	Connected Development
Flying Blind	Data Driven
Oversimplification	Managing Complexity

Open Data and Data Formats

Share Alike and Share Data

(This doesn't exist, but we think it should.)

Build and promote communities of research.

Pasteur's Quadrant

Stokes argues basic/applied goals need not trade off

	Low Emphasis on Applied Work	High Emphasis on Applied Work
High Emphasis on Basic Science	How to translate to real world? (**Bohr**)	 (**Pasteur**)
Low Emphasis on Basic Science	X	What principle can be derived? (**Edison**)

OLI Development and Use (2006)

Use

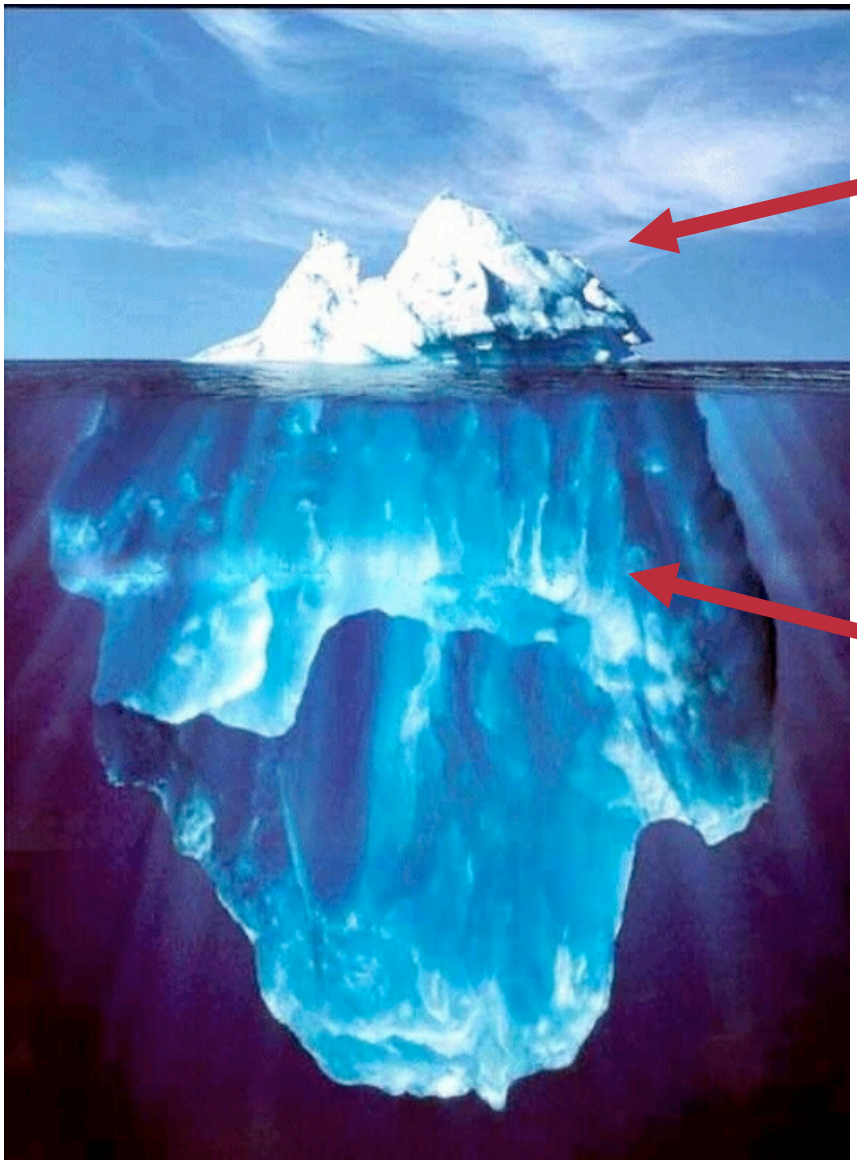
- 117,963 Course Enrollments (Academic)
- Used by 1,809 Instructors in 1,050 Institutions
- 1,148,807 Independent Learners (Registered and Anonymous)

Development

- 44 Academic courses have been created
- By 104 contributing Faculty from 55 Institutions

OLI Projects

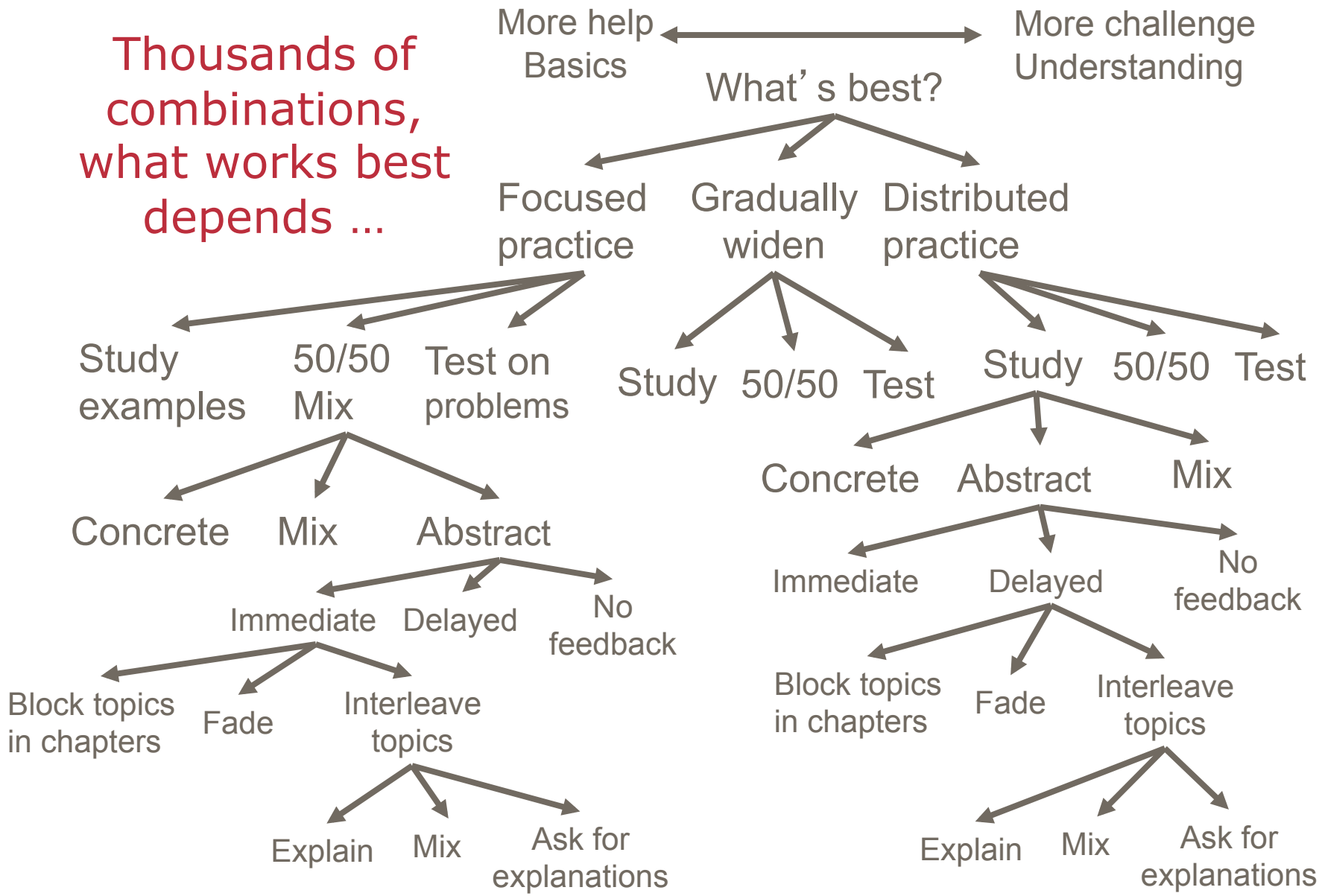
- Open Professionals Education Network (OPEN) free services for TAACCCT grantees
- Community College Open Learning Initiative (CC-OLI)
- Next Generation Learning Challenge Projects
- Evaluation Pilots: WGU, Texas & Washington
- Carnegie Foundation Statway
- Introduction to Computer Science
- UMUC Development/Adaptation project
- OLNet – Open Education Research Network
- Hewlett Packard Catalyst: Measuring Learning



What we know about our own learning

What we do *not* know

Thousands of combinations, what works best depends …



Koedinger, K. "Instructional Complexity"

Many other choices: animations vs. diagrams vs. not, audio vs. text vs. both, …