The Open Learning Initiative

Candace Thille

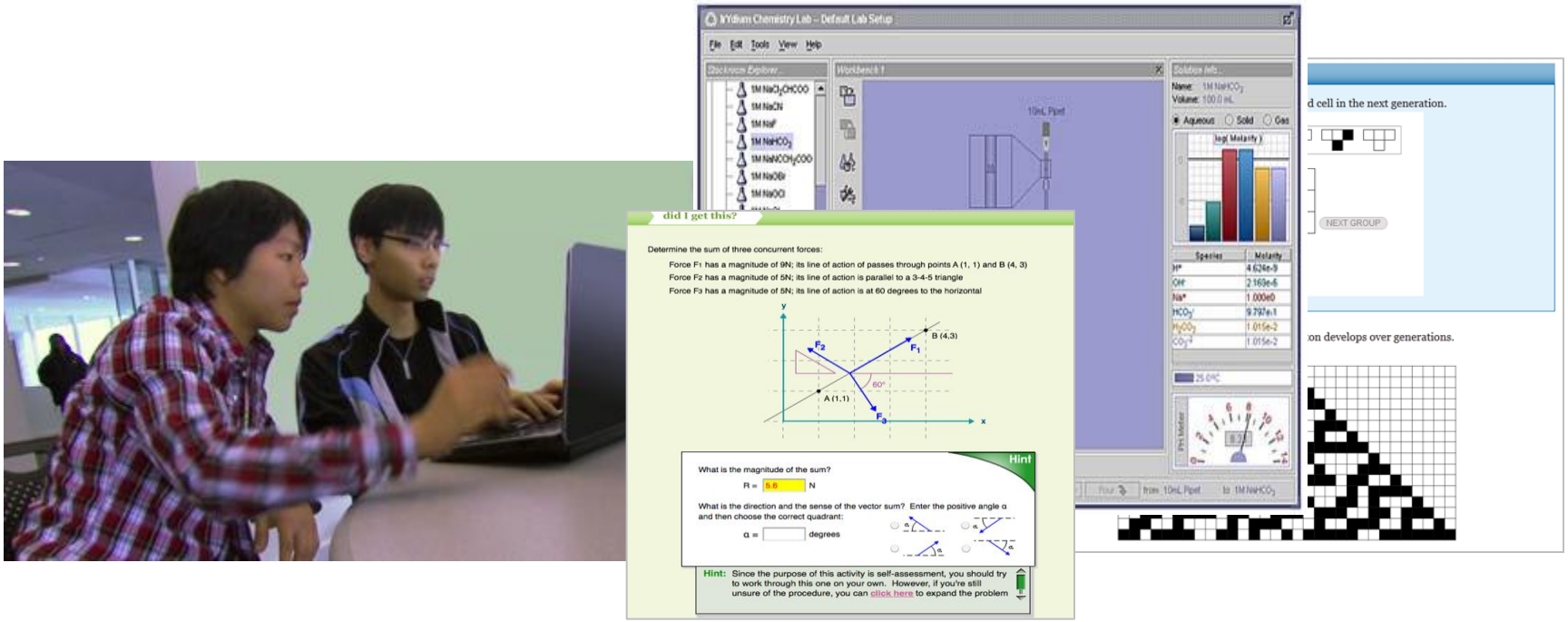
Director, Open Learning Initiative

Open Learning
Initiative
Carnegie Mellon University

October 2012

What is the Open Learning Initiative?

Open online learning environments based on the **science of learning** and designed to improve both quality & productivity in higher education.

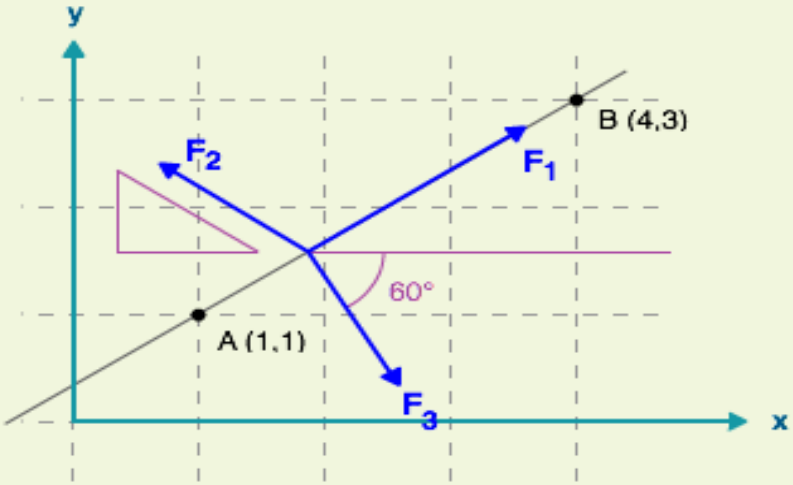


Determine the sum of three concurrent forces:

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



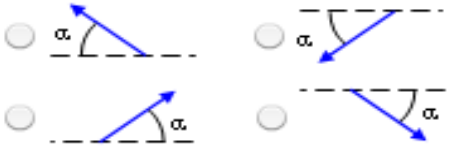
Hint

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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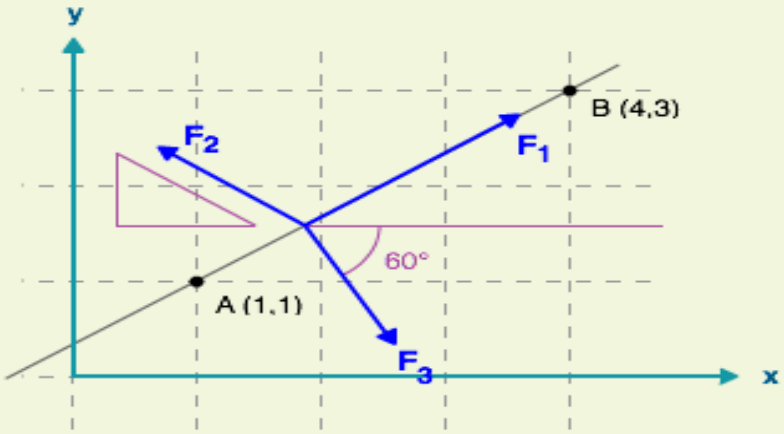

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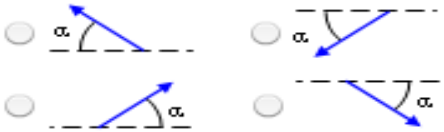

Recall:

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:

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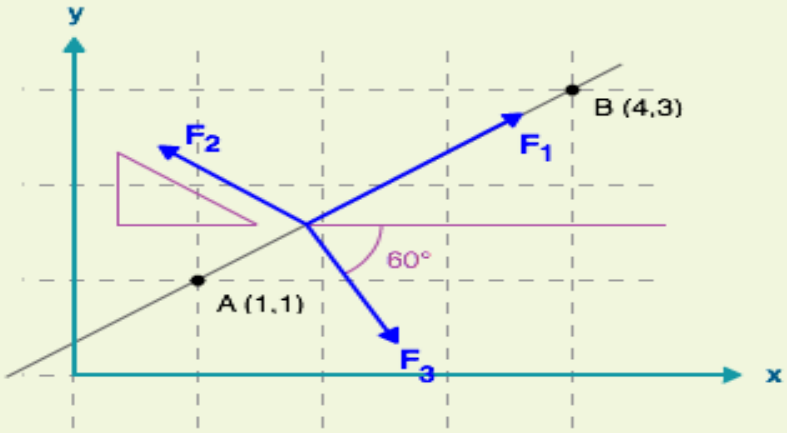

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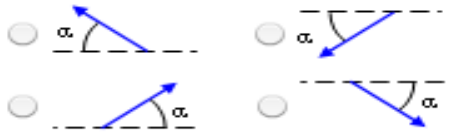

Recall:

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

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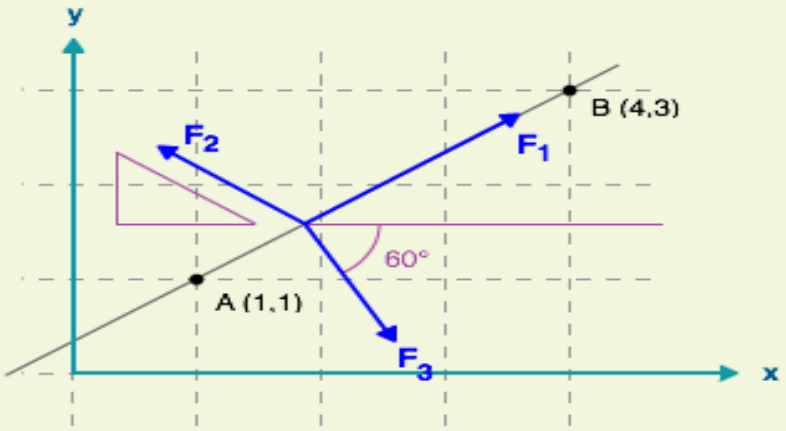


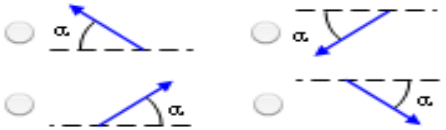
Hint

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:

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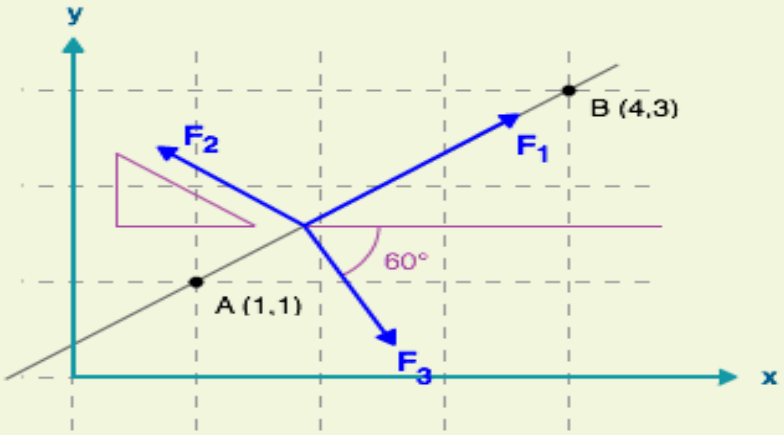


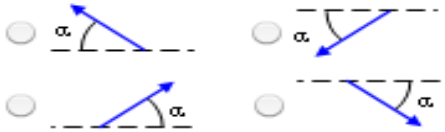
Hint

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.

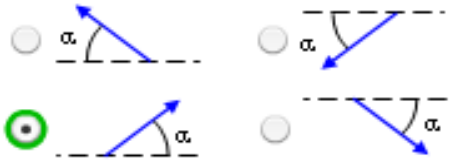
Hint

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.

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.

Is this well sample toxic? - 1

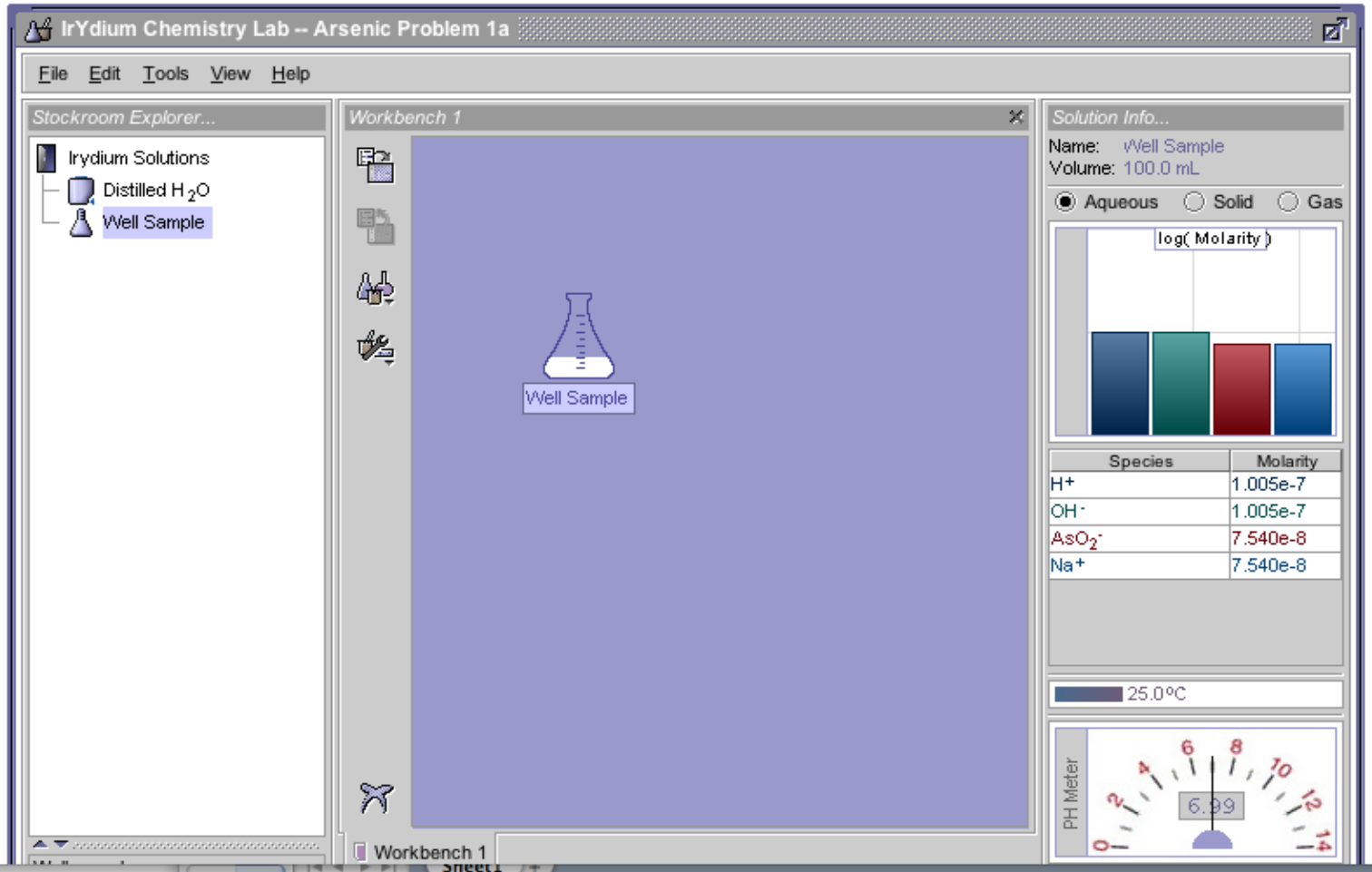
Acording to the WHO, the recommended limit for arsenic in drinking water is 10 micrograms per liter. While is not easy to answer if a well is toxic or not, a simpler question that can be answered is: Is the concentration of arsenic larger than the WHO recommendation?

If so, we may consider toxic this water source. If not, we may say that is arsenic-wise safe to drink this water.

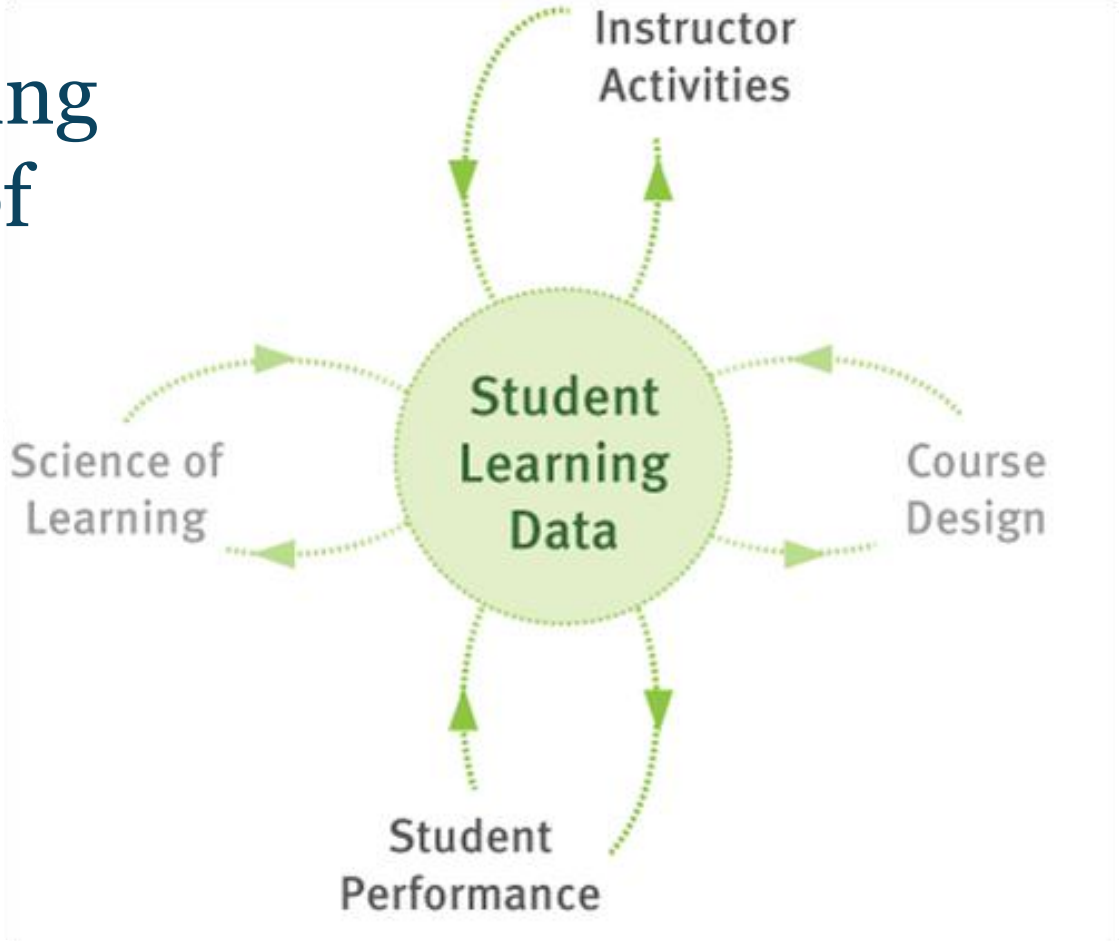
Activity 1: How many micrograms per liter of As is in the sample? (Please give your answer to 3 significant figures) Check Hint

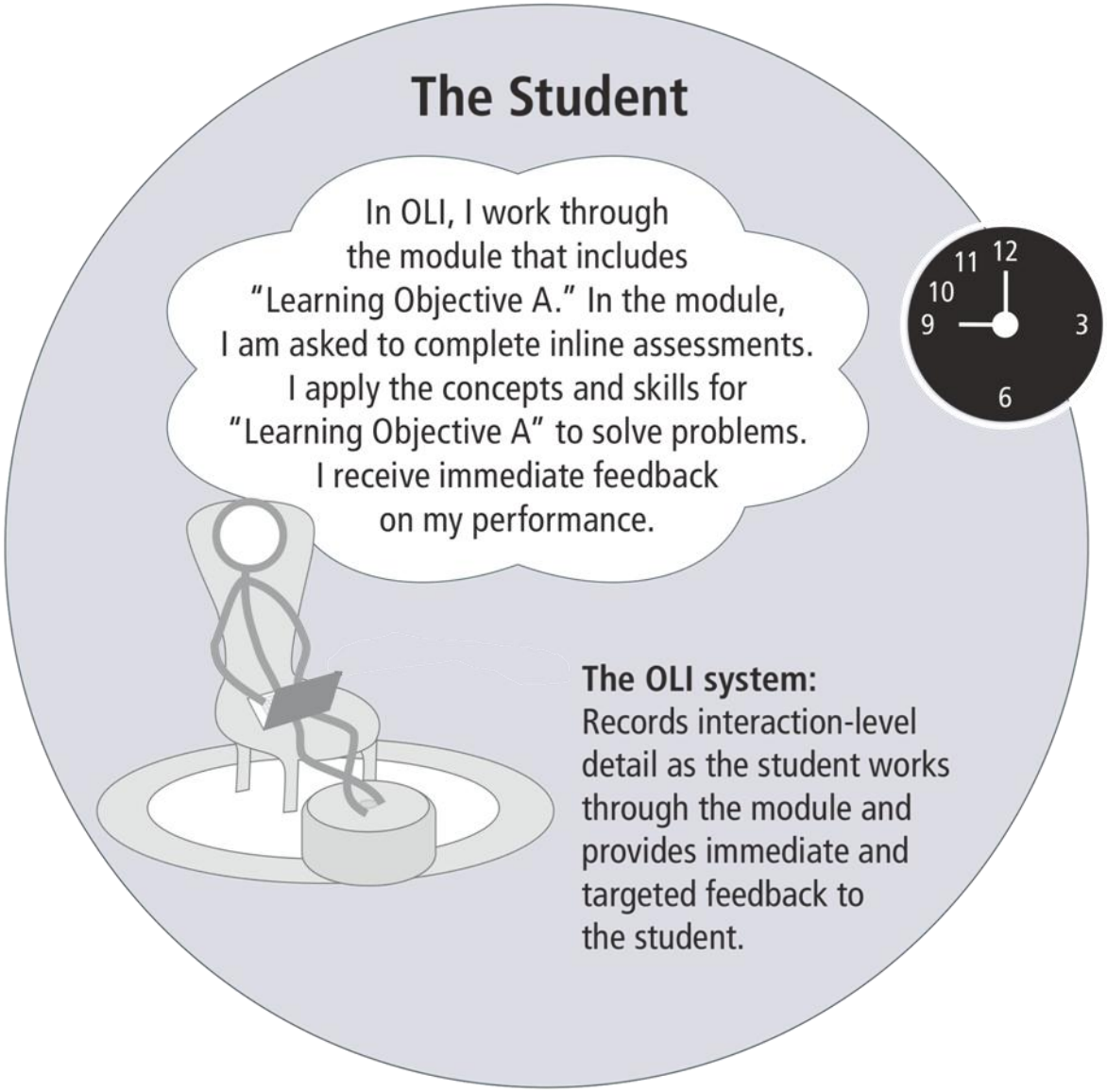
56.4 micrograms/L

The virtual lab shows solution information in moles, grams or molarity. Remember to pay attention to what quantity is currently being shown. Please try again



Feedback: Changing the Productivity of Learners and Teachers




The Student
In OLI, I work through the module that includes "Learning Objective A." In the module, I am asked to complete inline assessments. I apply the concepts and skills for "Learning Objective A" to solve problems. I receive immediate feedback on my performance.
12
11
10
9
3
6
The OLI system:
Records interaction-level detail as the student works through the module and provides immediate and targeted feedback to the student.

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]

Module 1

Examining Distributions

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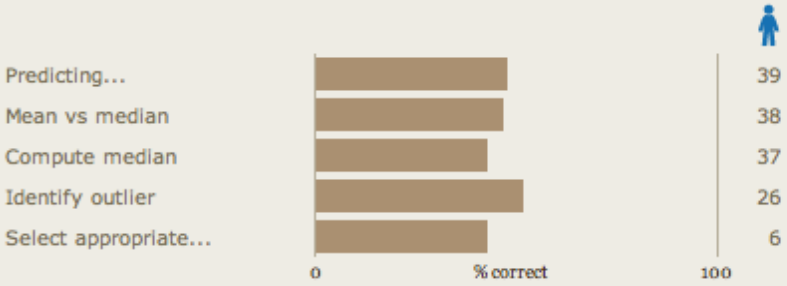
Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.
[» Hide Details...]

Estimated Learning *by Student*

Class Accuracy by *Sub-Objective*

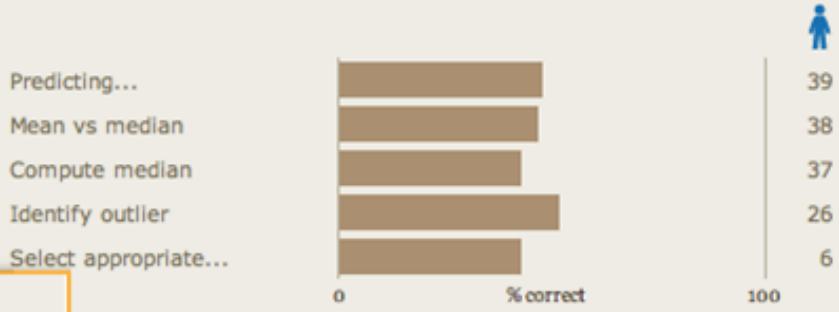


Relate measures of center and spread to the shape of the distribution, and choose the appropriate measures in different contexts.
[» Hide Details...]

Estimated Learning *by Student*

40 students
1 dot = 1 students

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

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39 of 40 st

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[4]

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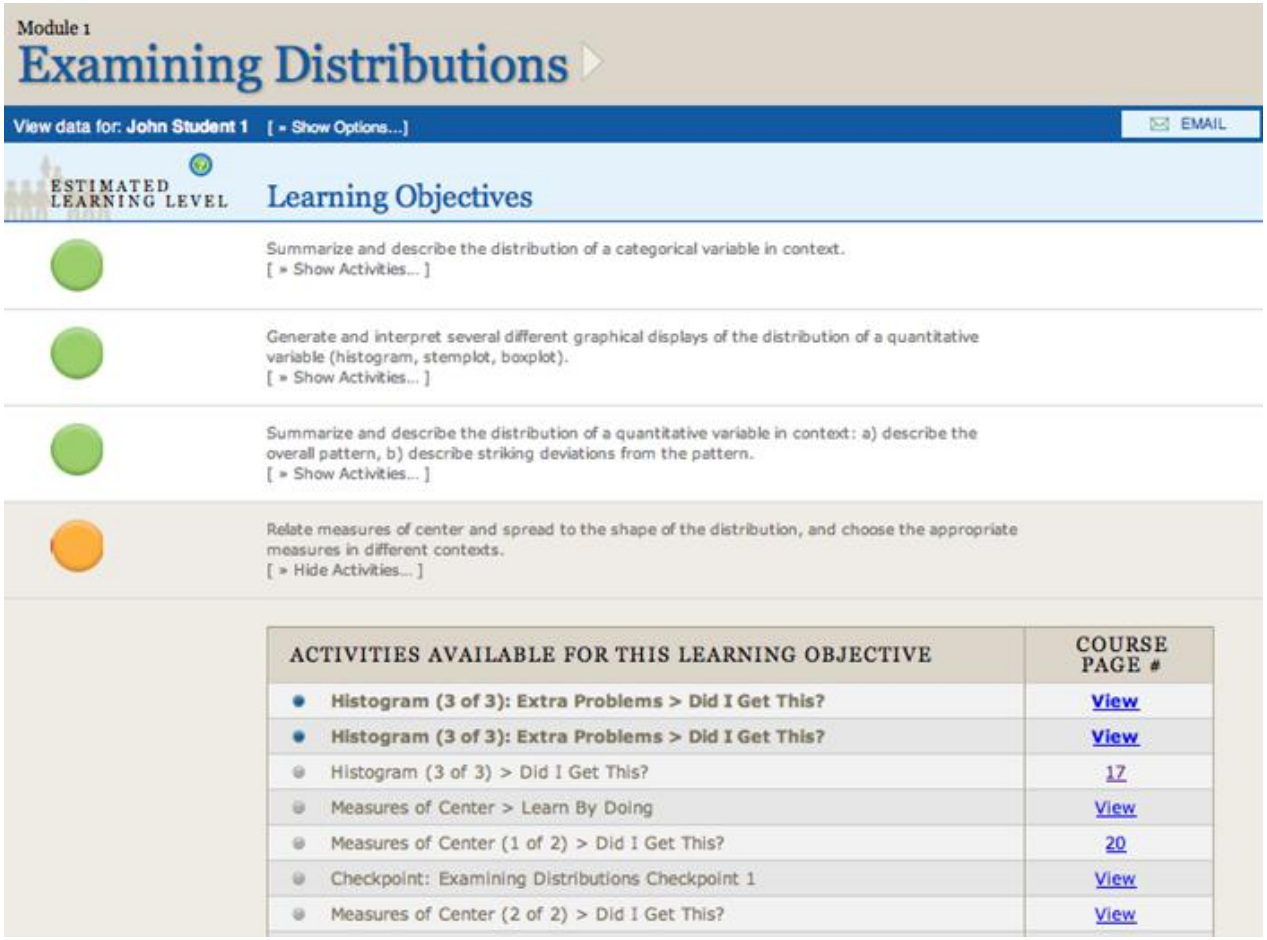
Checkpoints and Quizzes

» Checkpoint: Examining Distributions Checkpoint 1 [38]

» Checkpoint: Examining Distributions Checkpoint 2 [36]

Single Student View



Measures of Center

Readability of Cancer Pamphlets

Background

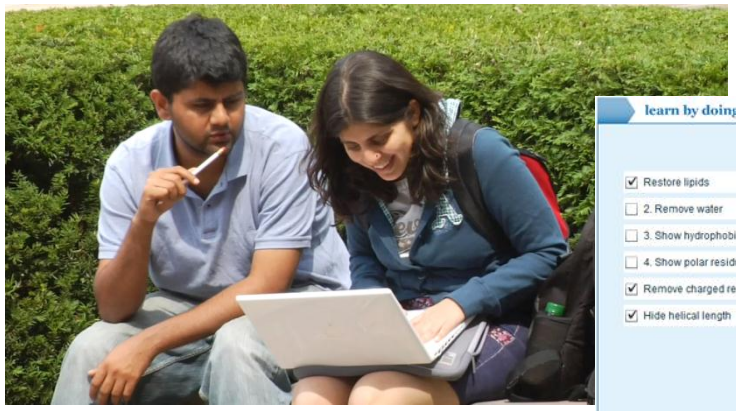
A study was done in order to find out whether pamphlets containing information for cancer patients are written at a level that the cancer patients can understand. Tests were administered to measure the reading levels of 63 cancer patients, and the readability levels of 30 cancer pamphlets were evaluated based on such factors as the lengths of the sentences and the number of polysyllabic words. Both the reading and readability levels correspond to grade levels, but patients' reading levels of less than grade 3 and above grade 12 cannot be determined exactly. (**Source**: Short, Moriarty, and Cooly. (1995). "Readability of Educational Materials for Cancer Patients." *Journal of Statistics Education*, v.3, n.2)

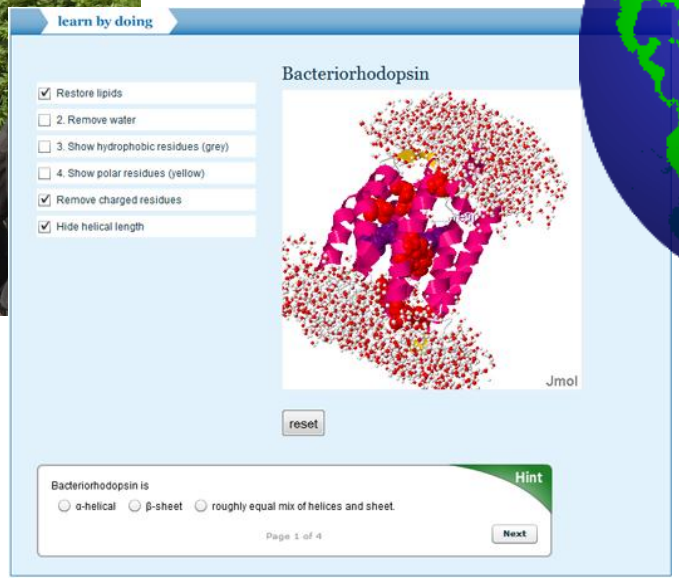
The following tables indicate the number of patients at each reading level and the number of pamphlets at each readability level.

Patients' Reading Level	<3	3	4	5	6	7	8	9	10	11	12	>12
Count	6	4	4	3	3	2	6	5	4	7	2	17

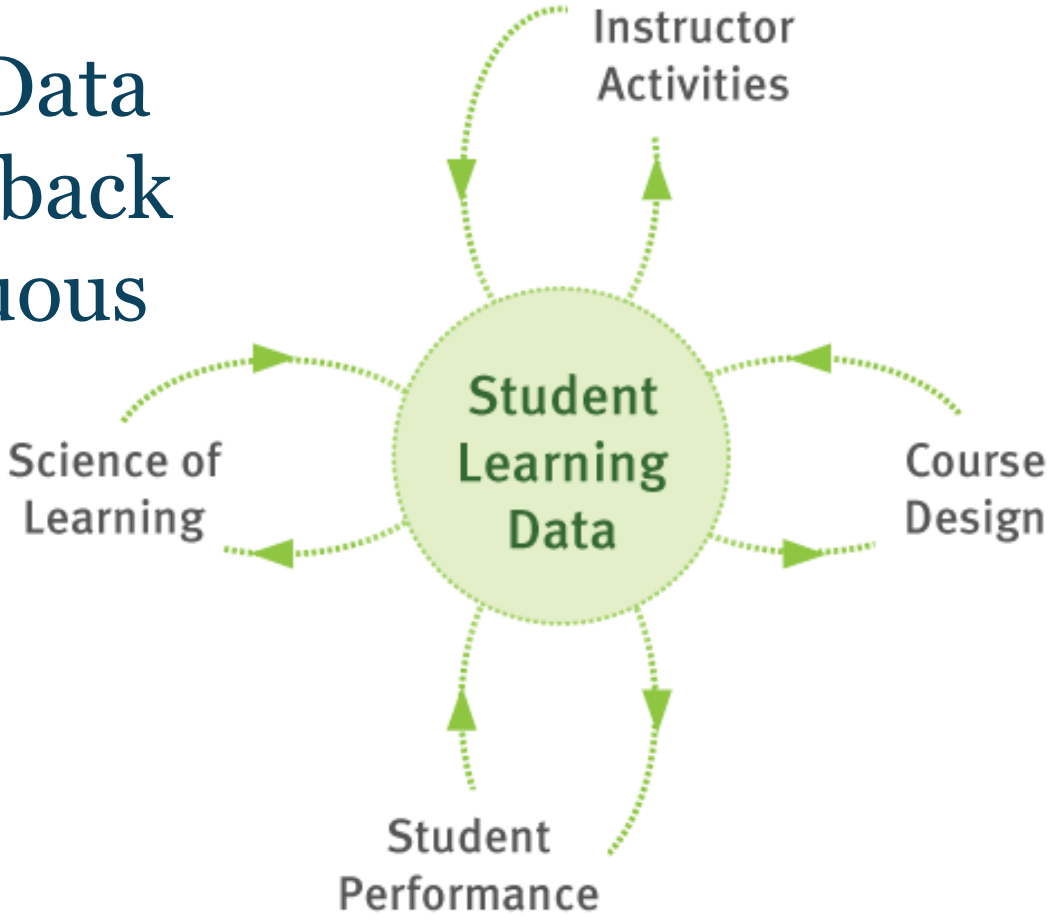
Pamphlets' Readability Level	6	7	8	9	10	11	12	13	14	15	16
Count	3	3	8	4	1	1	4	2	1	2	1

What Are the Affordances of the Technology?

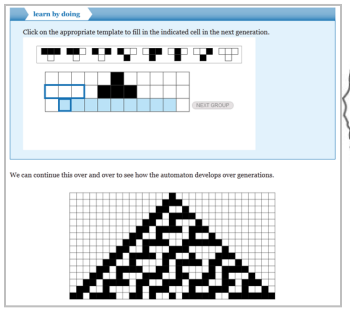




The “Killer App” Data Collection & Feedback Loops for Continuous Improvement



LearnLab:
Transforming Education Research



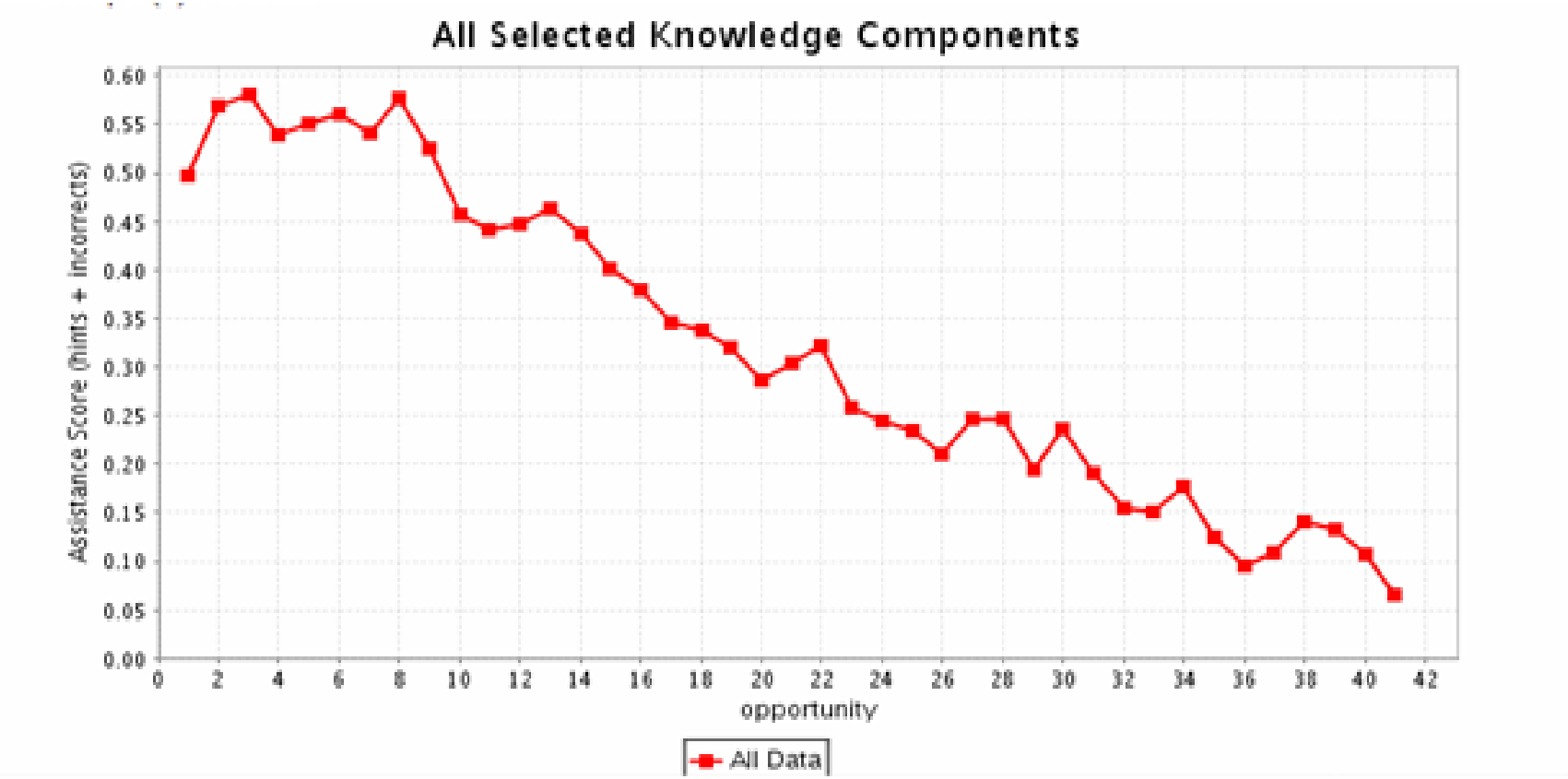
LearnLab
Pittsburgh Science of Learning Center

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

NSF Science of Learning Center

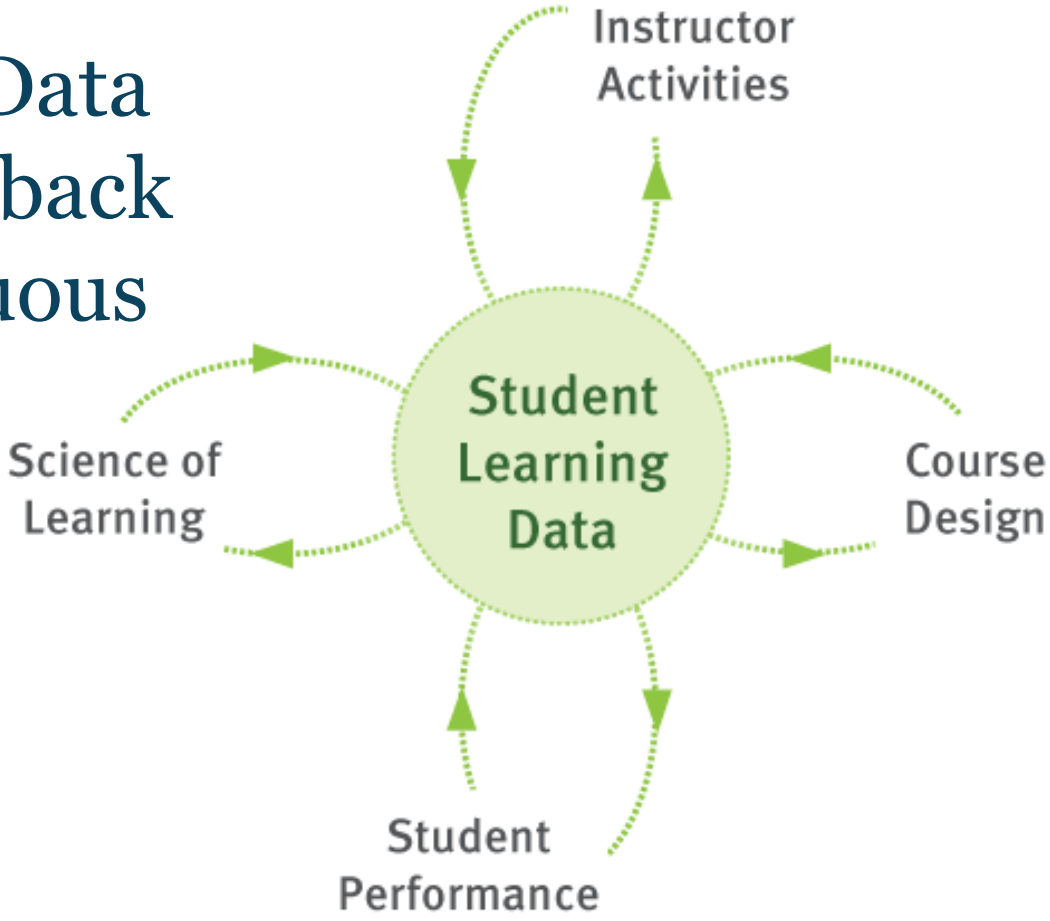
- 10 years, ~$50 million
- Tech enhanced courses, assessment, & research
- School cooperation for data collection

Learning Curve Analysis

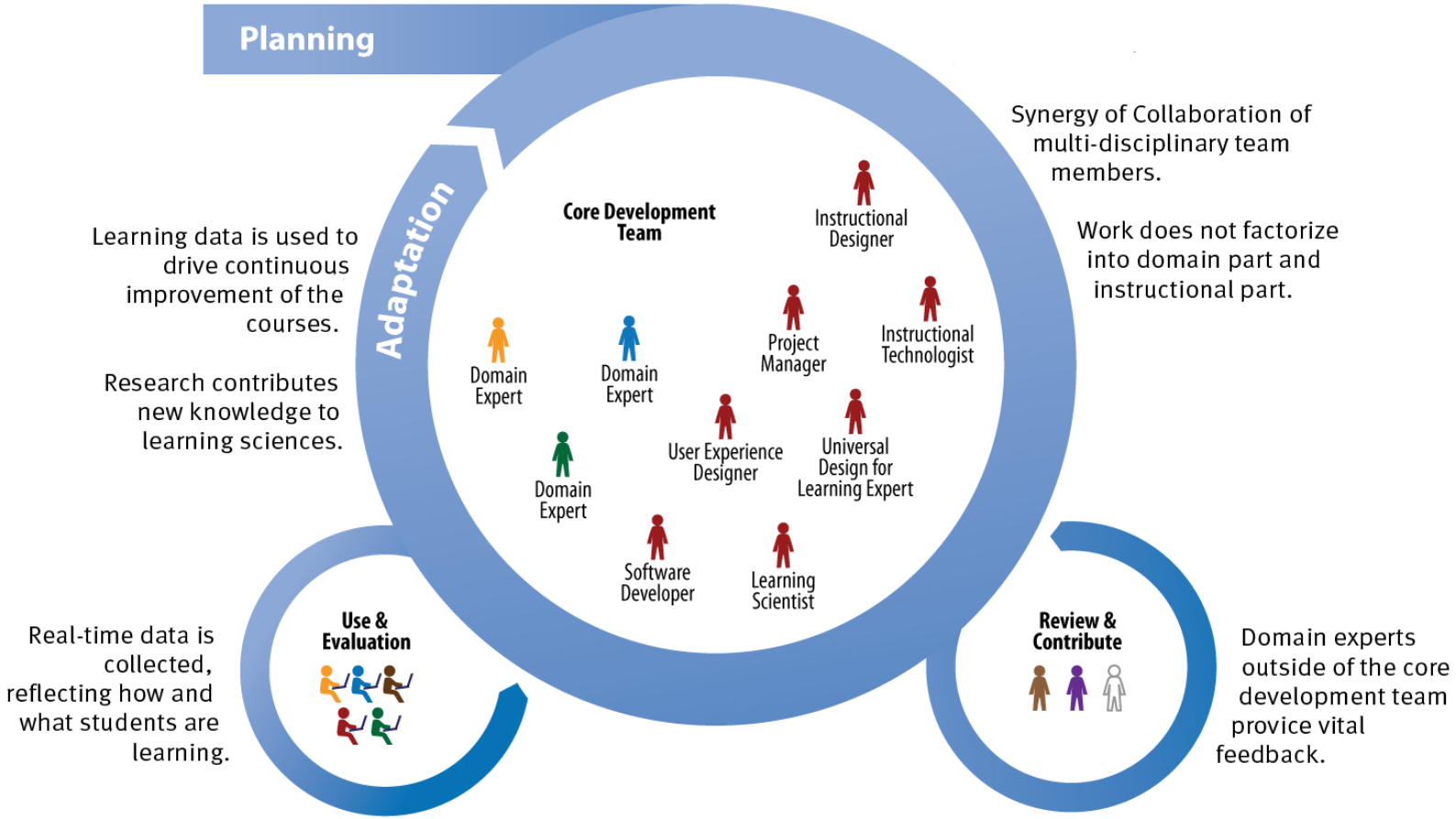


DataShop: Pittsburgh Science of Learning Center

The “Killer App” Data Collection & Feedback Loops for Continuous Improvement



OLI Development Process



Better insight ➡ better *courses*

Past research

- Careful “cognitive task analysis” produces *much* better courses

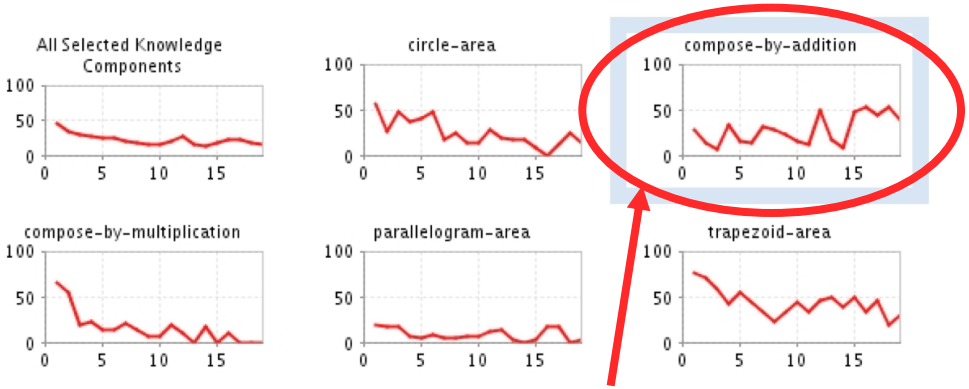
OLI Chemistry, equilibrium topic:

Previously: 20% correct on exam

After Redesign: 60%

New opportunity

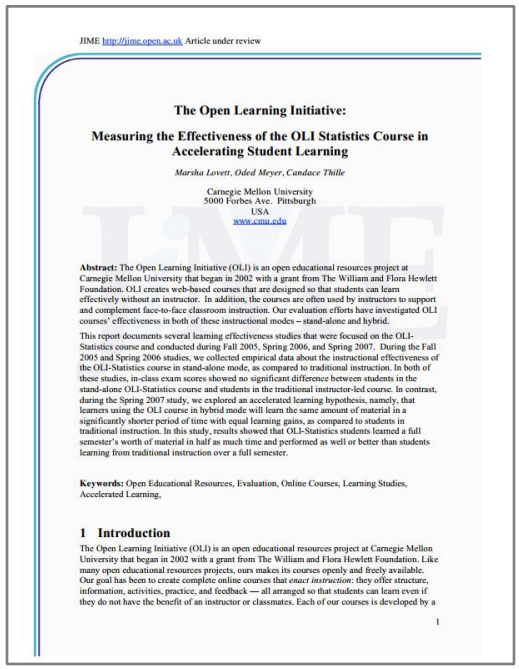
- Ed tech provides data for automated analysis



Flat learning curve

Discovery opportunity!

Proven Results



JIME http://jime.open.ac.uk Article under review

The Open Learning Initiative:

Measuring the Effectiveness of the OLI Statistics Course in Accelerating Student Learning

Marsha Lovett, Oded Meyer, Candace Thille

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5000 Forbes Ave. Pittsburgh
USA
www.cmu.edu

Abstract: The Open Learning Initiative (OLI) is an open educational resources project at Carnegie Mellon University that began in 2002 with a grant from The William and Flora Hewlett Foundation. OLI creates web-based courses that are designed so that students can learn effectively without an instructor. In addition, the courses are often used by instructors to support and complement face-to-face classroom instruction. Our evaluation efforts have investigated OLI courses' effectiveness in both of these instructional modes – stand-alone and hybrid.

This report documents several learning effectiveness studies that were focused on the OLI-Statistics course and conducted during Fall 2005, Spring 2006, and Spring 2007. During the Fall 2005 and Spring 2006 studies, we collected empirical data about the instructional effectiveness of the OLI-Statistics course in stand-alone mode, as compared to traditional instruction. In both of these studies, in-class exam scores showed no significant difference between students in the stand-alone OLI-Statistics course and students in the traditional instructor-led course. In contrast, during the Spring 2007 study, we explored an accelerated learning hypothesis, namely, that learners using the OLI course in hybrid mode will learn the same amount of material in a significantly shorter period of time with equal learning gains, as compared to students in traditional instruction. In this study, results showed that OLI-Statistics students learned a full semester's worth of material in half as much time and performed as well or better than students learning from traditional instruction over a full semester.

Keywords: Open Educational Resources, Evaluation, Online Courses, Learning Studies, Accelerated Learning.

1 Introduction

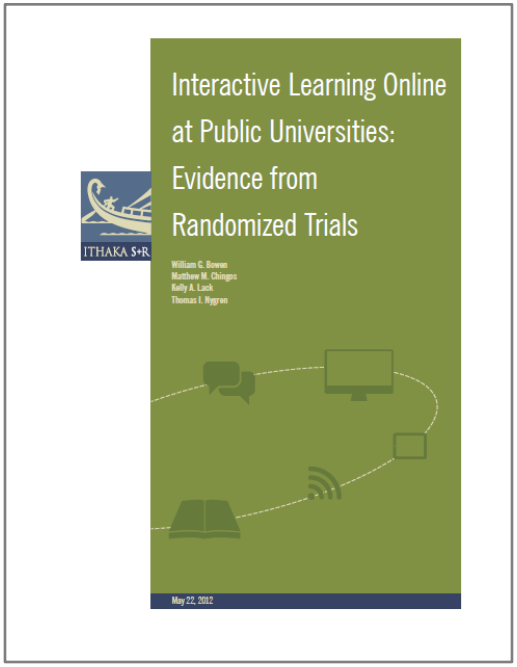
The Open Learning Initiative (OLI) is an open educational resources project at Carnegie Mellon University that began in 2002 with a grant from The William and Flora Hewlett Foundation. Like many open educational resources projects, ours makes its courses openly and freely available. Our goal has been to create complete online courses that *enact instruction*; they offer structure, information, activities, practice, and feedback — all arranged so that students can learn even if they do not have the benefit of an instructor or classmates. Each of our courses is developed by a

1

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**.

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.

Proven Results

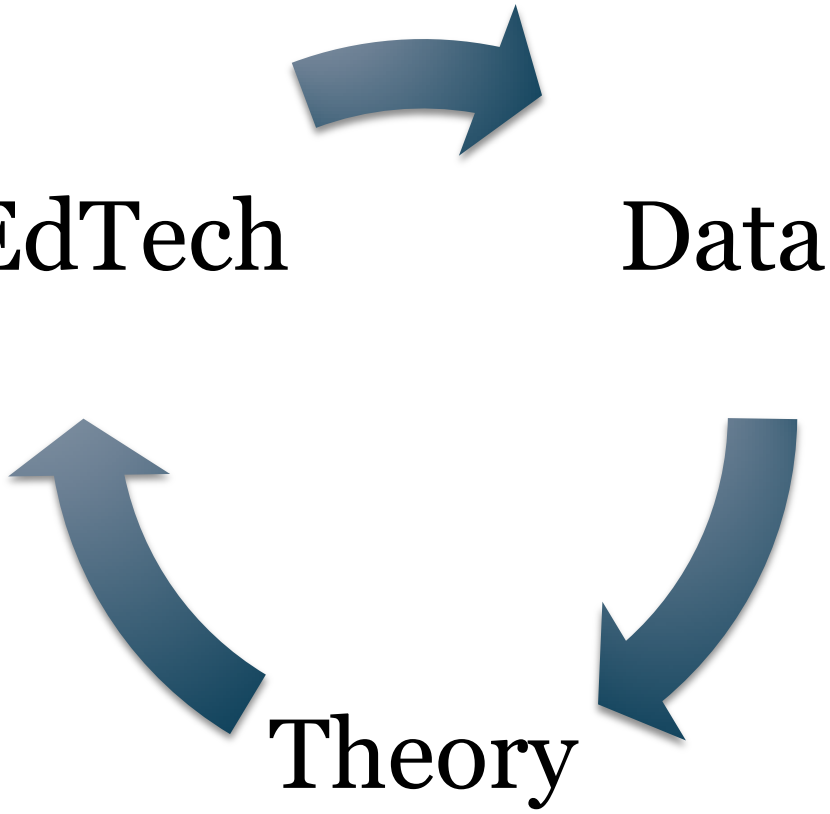


"The results of this study are remarkable; they show comparable learning outcomes for this basic course, with a promise of cost savings and productivity gains over time."

Deanna Marcum
Managing Director, Thaka S+R

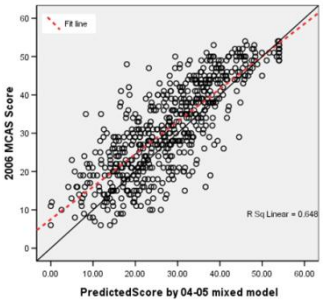
Bowen, W.G., Chingos, M.M., Lack, K.L., & Nygren, T.I. (2012). *Interactive Learning Online at Public Universities: Evidence from Randomized Trials.* ITHAKA.

Strategy for Educational Improvement

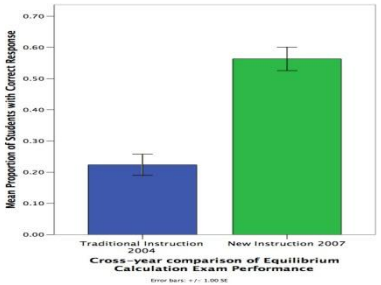


Better Science & Technology …

Improves Assessment



Increases Outcomes



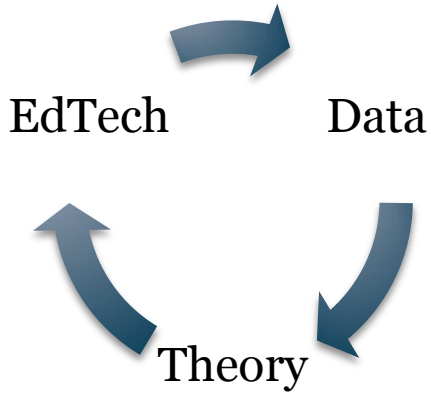
Accelerates Learning

> 100 hours
~3% gain

→

< 50 hours
~18% gain

Produces A Virtuous Cycle



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

"Improvement in Post Secondary Education will require converting teaching from a 'solo sport' to a community based research activity."

The late Herbert Simon,
Nobel Laureate & CMU Professor

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