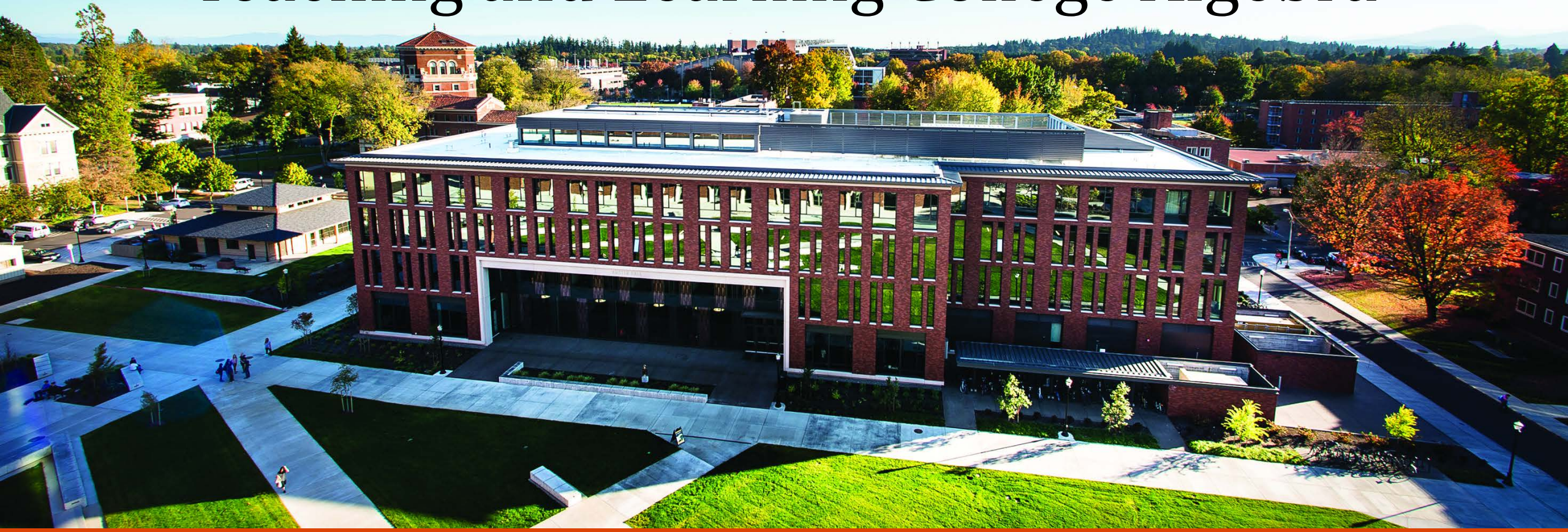
An Active Adaptive Approach to Teaching and Learning College Algebra



Sara Clark and Katy Williams
ORMATYC, April 28th, 2018

Oregon State University

Project Outline

About the Project

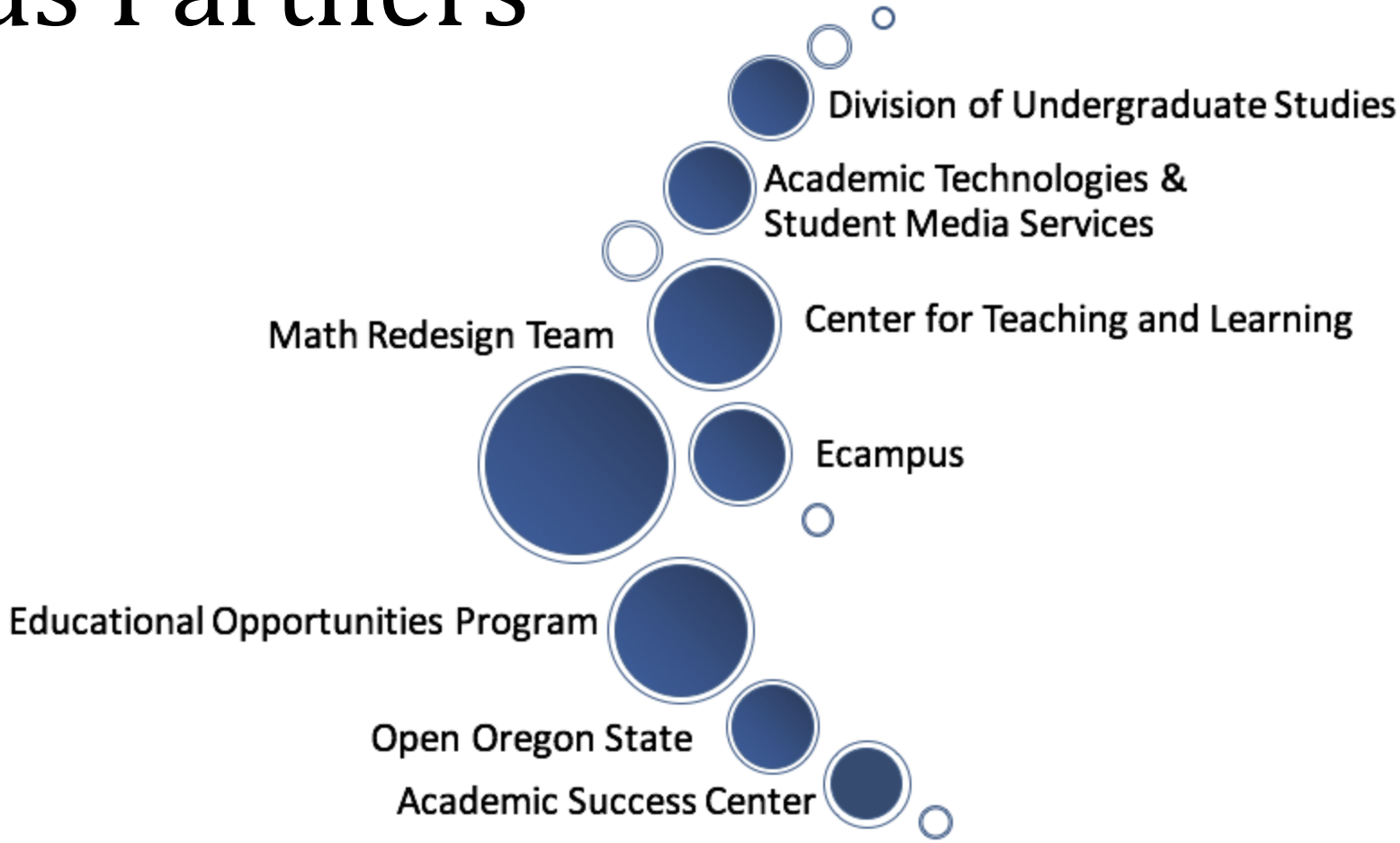
- **Opportunity**
  OSU is one of eight universities chosen to take part in this APLU Personalized Learning Consortium grant, funded by the Bill and Melinda Gates Foundation

- **Task**
  Integrate adaptive courseware into College Algebra (MTH 111)

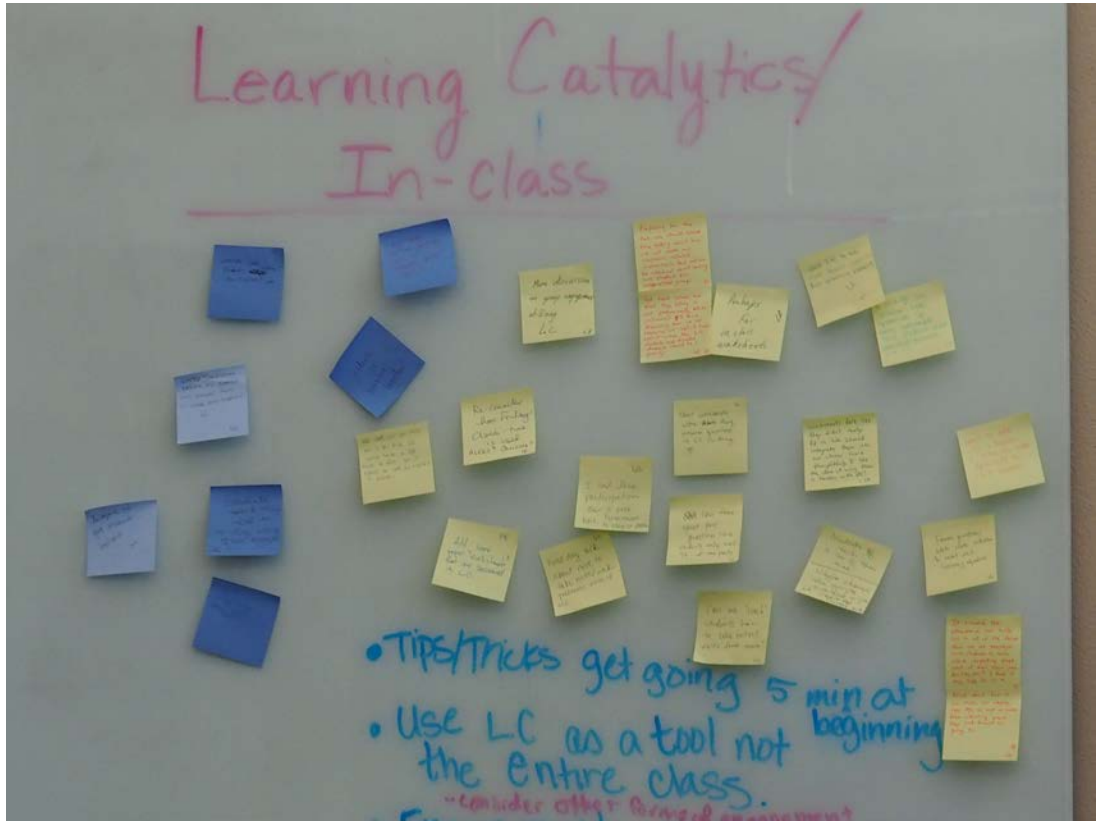
- **Team**
  Seven math instructors + TONS of support

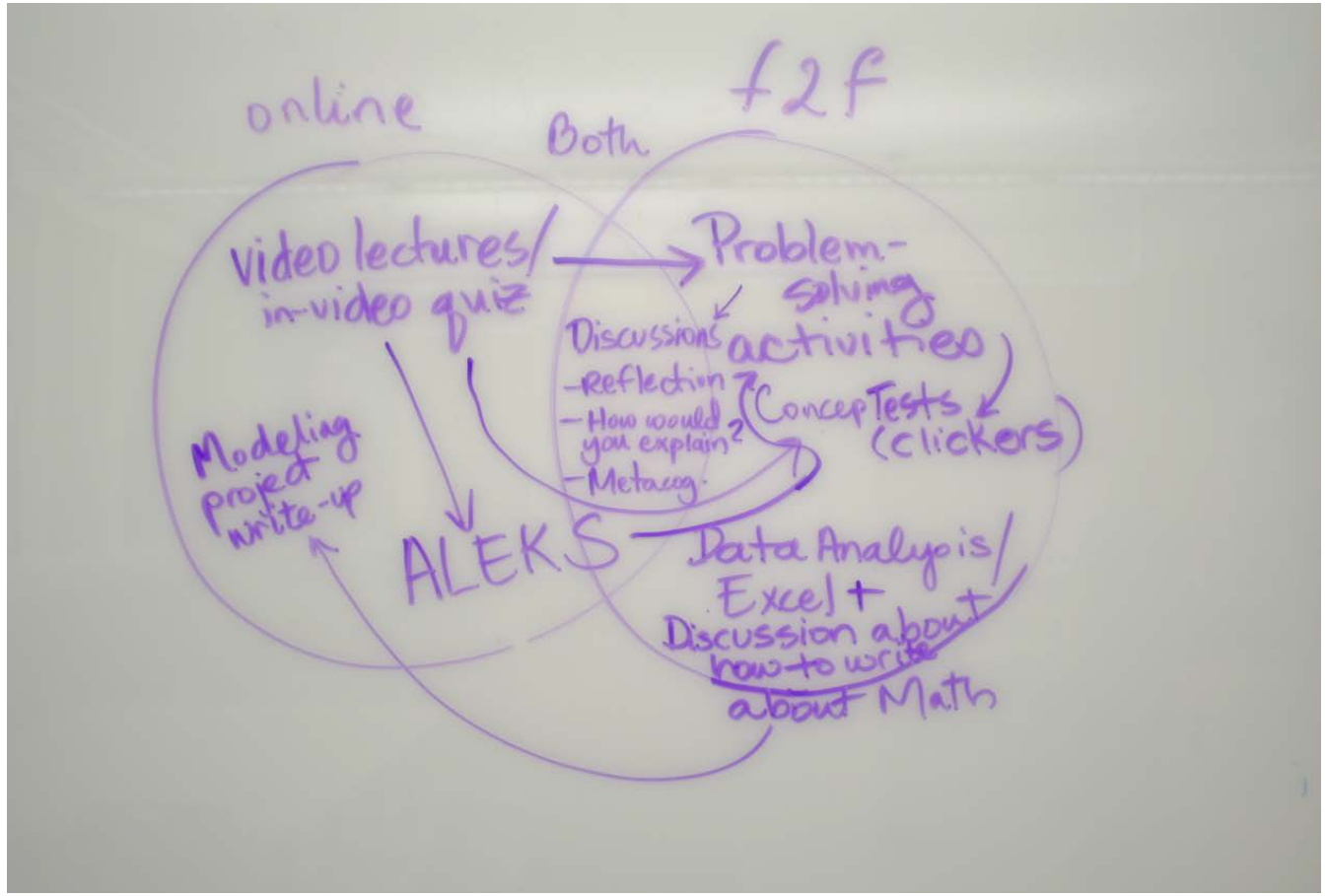
- **Our Goal**
  Create the BEST College Algebra course using evidence-based pedagogies and design strategies!

Campus Partners



Designing Our Blended Course

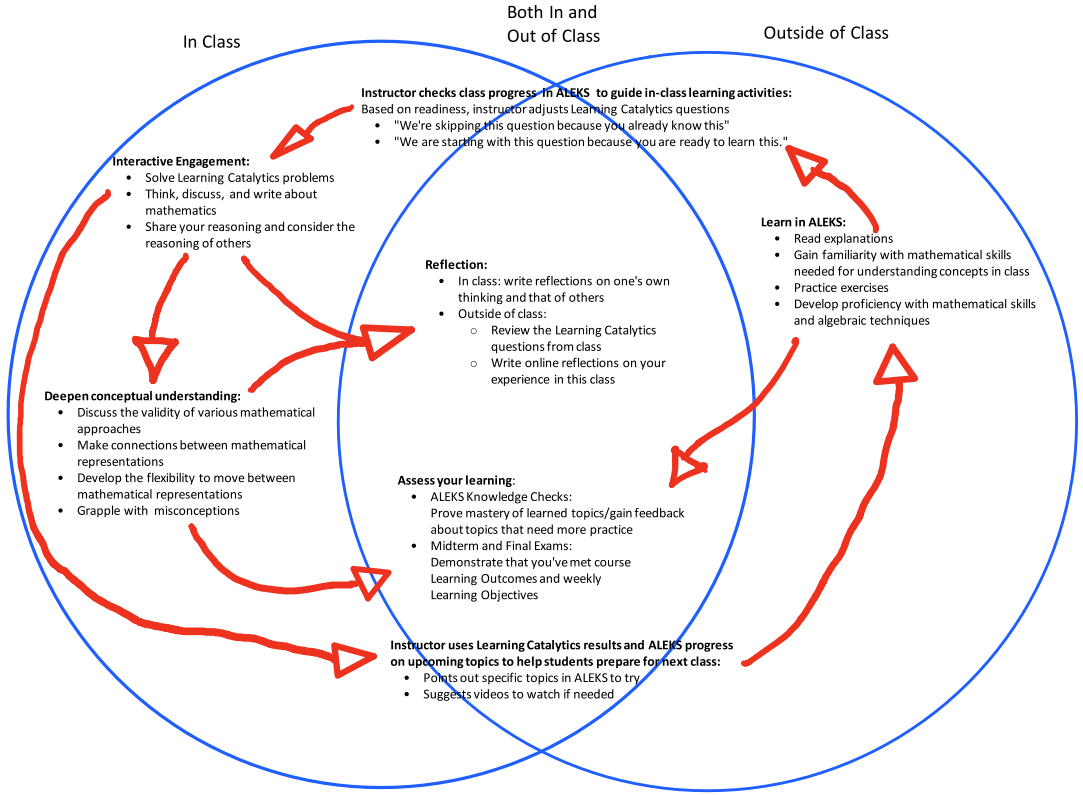




Mix Maps
Dec. ’16 → Mar. ‘17

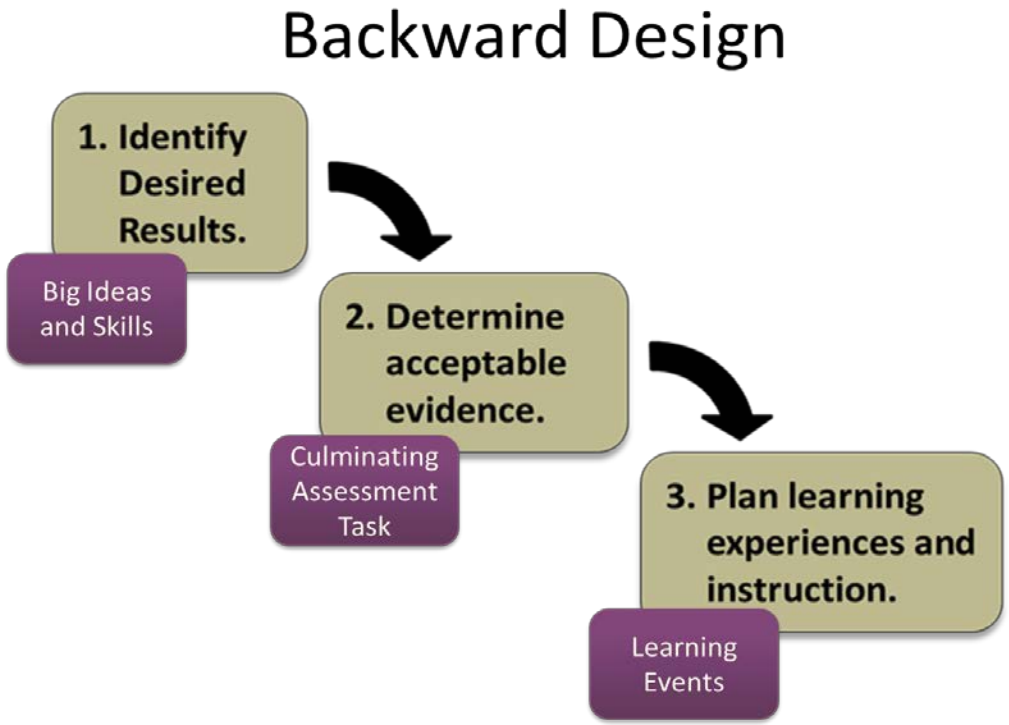
College Algebra Mix Map

Saturday, March 4, 2017 9:02 AM



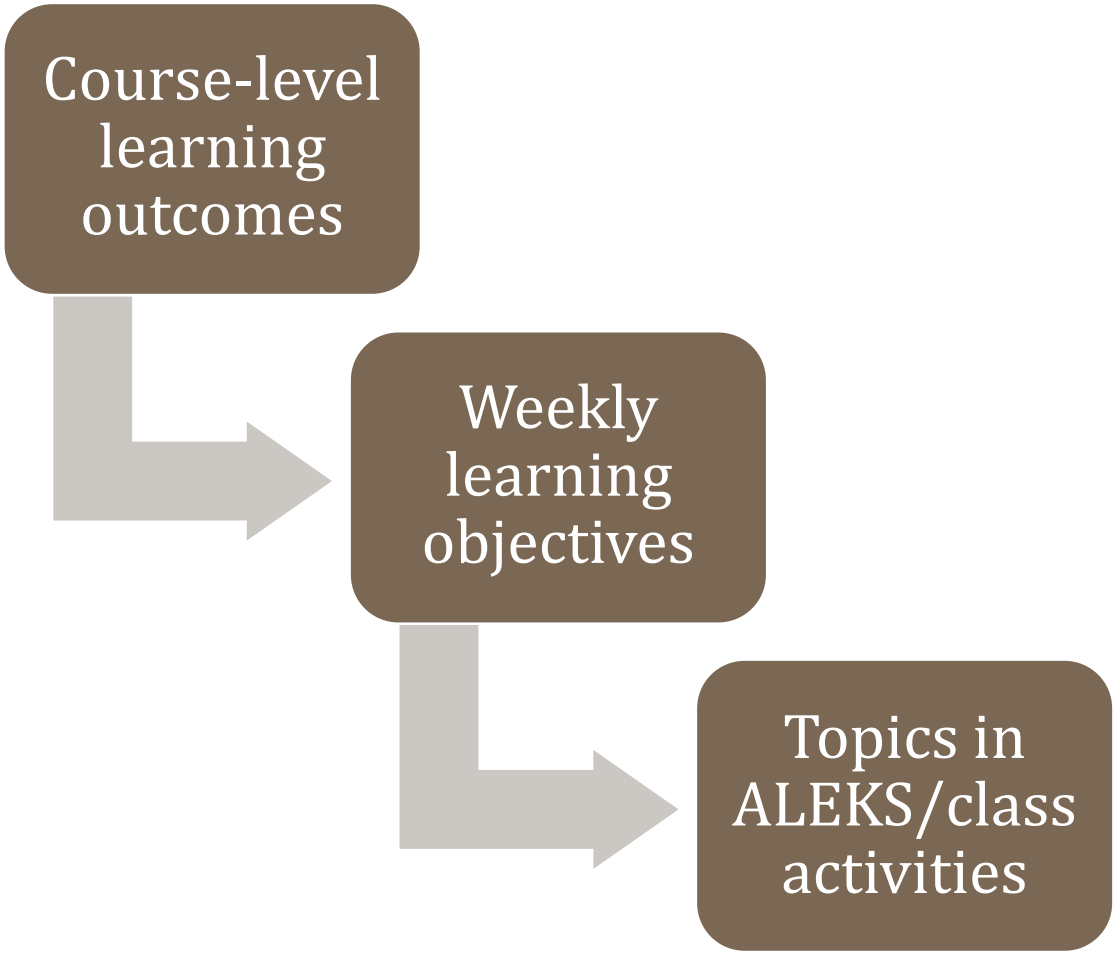
Three keys to success in designing a blended course using backward design

1. Alignment
2. Alignment
3. Alignment



Wiggins, G. P., & McTighe, J. (2005). *Understanding by design*. Association for Supervision & Curriculum Development.

Alignment in College Algebra



An Example of Backward Design and Alignment in MTH 111

Course Level Learning Outcome:
Apply the definition of function, identifying domain and range, and interpreting in context when appropriate.

Weekly Learning Objective:
Determine whether a given relation is a function from a verbal description, table, graph, or equation.

Learning/Mastering these topics in ALEKS:
Identifying functions from relations
Vertical line test

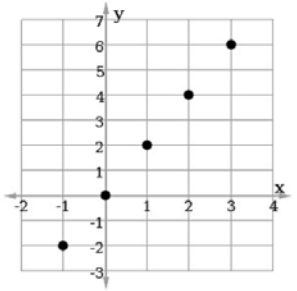
Questions on In-Class Activities:
See questions to right.

2) For each relation graphed below, determine if it is a function and state its domain and range.

a) Function: Yes No

Domain:

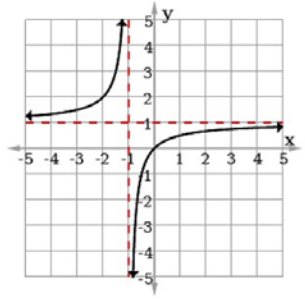
Range:



b) Function: Yes No

Domain:

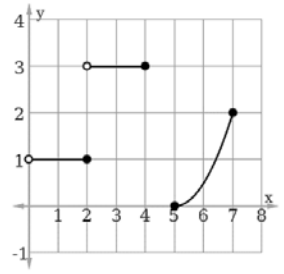
Range:



c) Function: Yes No

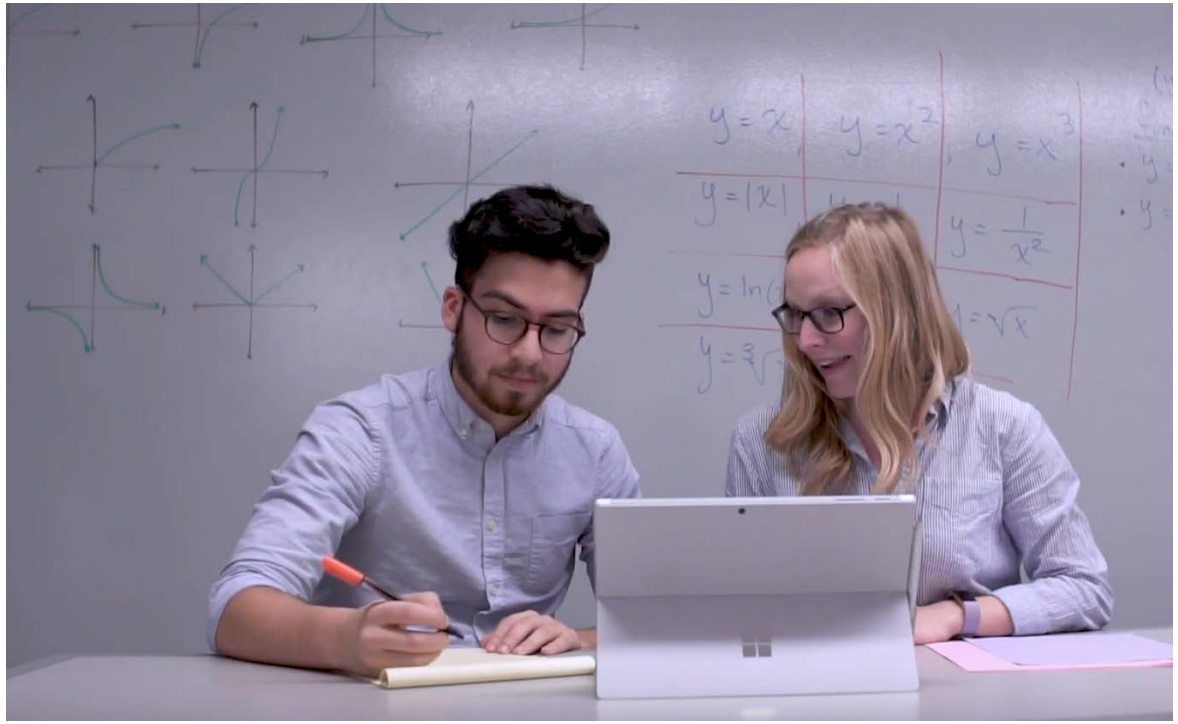
Domain:

Range:



How Adaptive Enables Active

- Two adaptive technologies
    - ALEKS and Learning Catalytics
- Out-of-class preparation in ALEKS
- In-class adaptive instruction



Adaptive Out of Class: ALEKS

Why Did We Choose ALEKS?

- Fall 2015
  - ALEKS Math placement Fall 2014
  - DFW rates for MTH 095 >40%
  - ALEKS added to developmental math Fall 2015
  - Originally emporium-style, now online only
- Summer 2016
  - APLU's Personalized Learning Consortium Grant
  - Target high attrition courses, including College Algebra
  - Success in developmental math made ALEKS natural choice
  - ALEKS flexibility for content re-ordering a happy accident

ALEKS in College Algebra – First Attempt

- ALEKS Structure
  - Large Weekly Objectives
    - on average 22 goal topics per week
  - 3 Scheduled Comprehensive Knowledge Checks with Mastery Goals

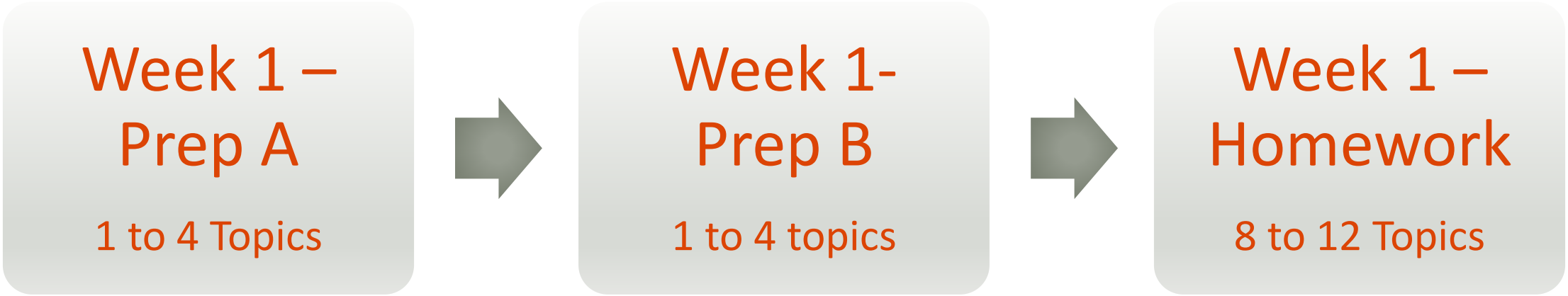
- Success & Failures
  - Positive feedback from students about using ALEKS
  - Students struggled to complete large objectives
  - No grade incentive to go back and finish incomplete assignments
  - Did not ingrate ALEKS with LMS

ALEKS in College Algebra 2nd Attempt

- ALEKS Structure
  - 3 Weekly Objectives
    - 2 smaller prep assignments
    - 1 larger homework
    - Average 16 goal topics per week total
  - 5 Pie Progress Goals
  - "Open Pie" for exam review
  - Final Scheduled Comprehensive Knowledge Check with Mastery Goal of 85%

- Successes & Failures
  - Still getting positive feedback
  - Students come to class prepared
  - They still often wait until the last minute to work on the larger assignment
  - The Pie Progress Goals have given student the motivation to complete past due objectives
  - ALEKS integrated into Canvas

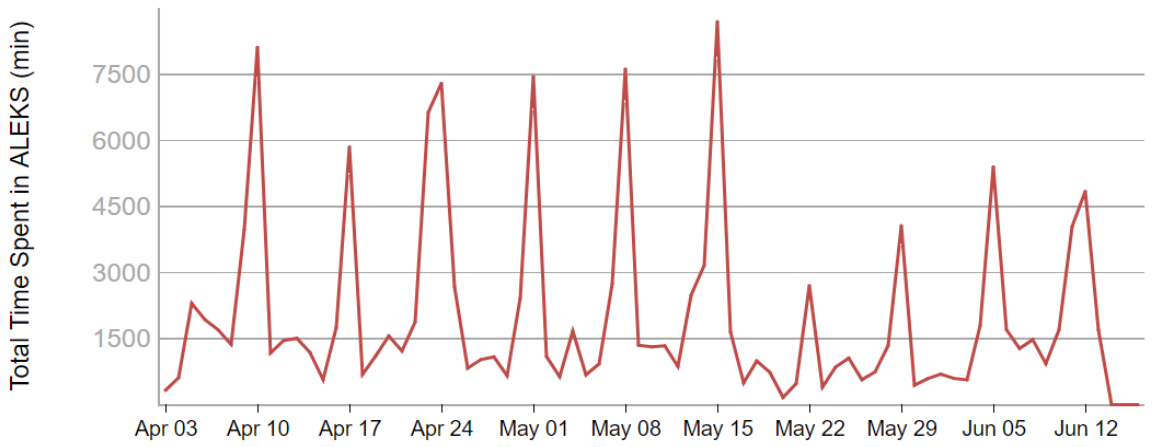
ALEKS Objectives Structure



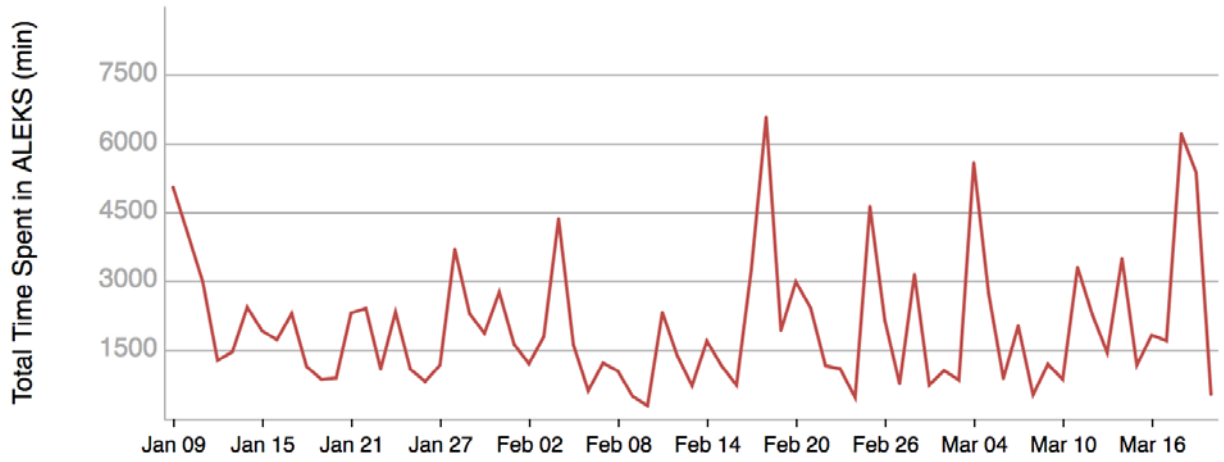
- Each week students complete two prep assignments before class
- There is one larger homework objective at the end of the week

Total Time Trend

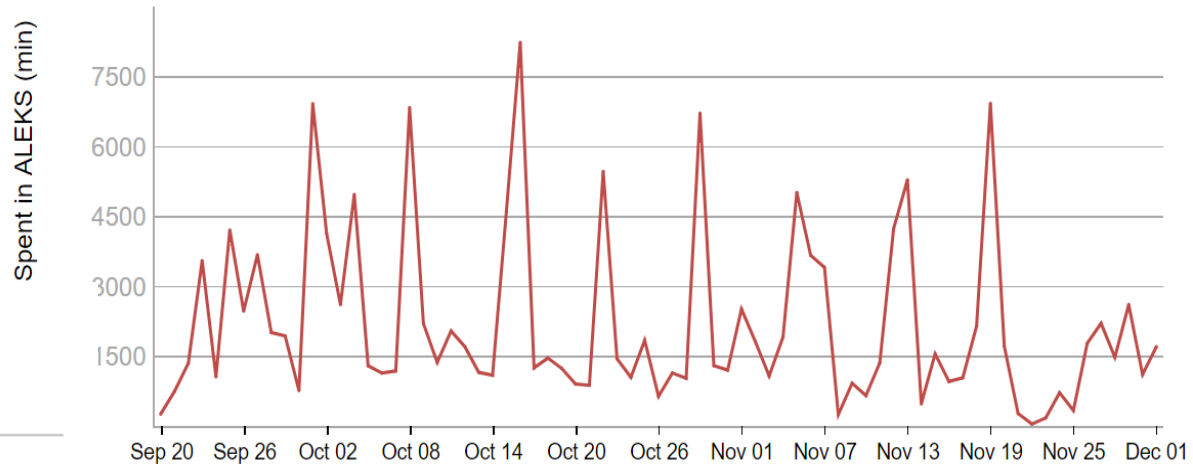
Spring 2017 (54 students)



Winter 2018 (63 students)



Fall 2017 (61 students)



Overall Objective Completion

Spring 2017

1 Weekly Objective

- 68% objective completion on average

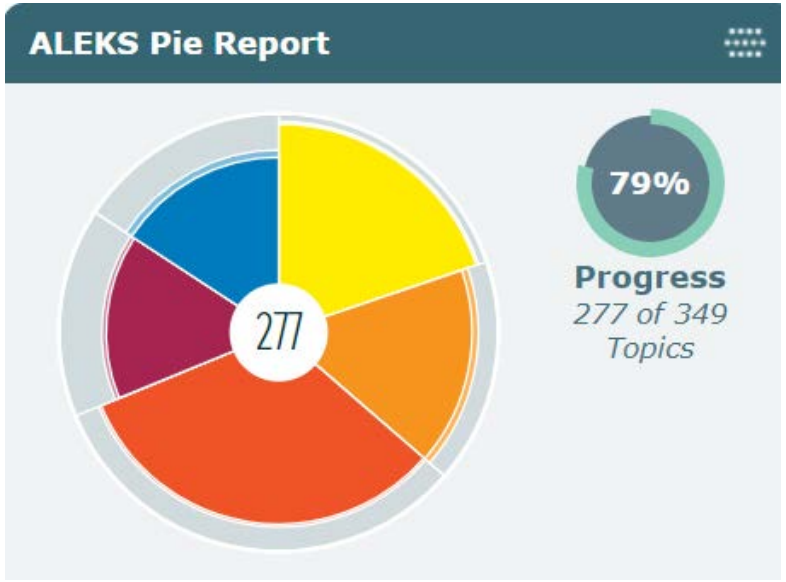
Fall 2017 and Winter 2018

3 weekly objectives

- 85% prep objective completion on average
- 75.5% homework objective completion on average

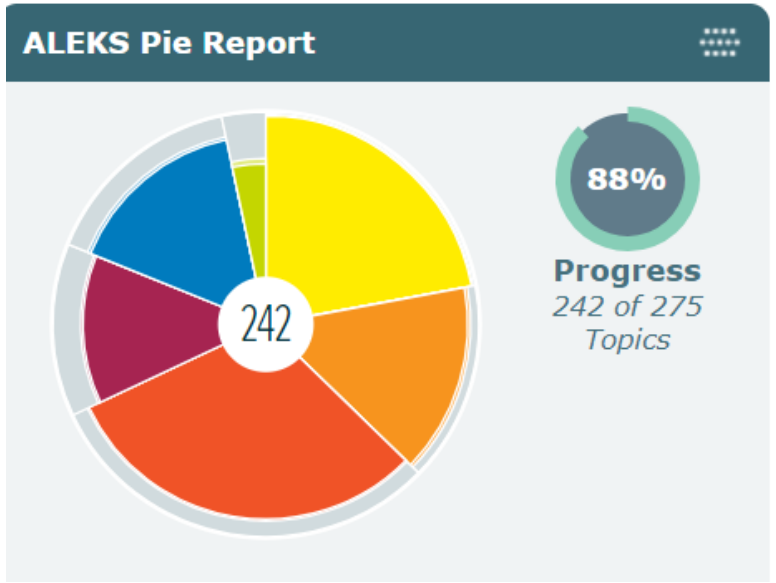
End of Course Mastery

Spring 2017



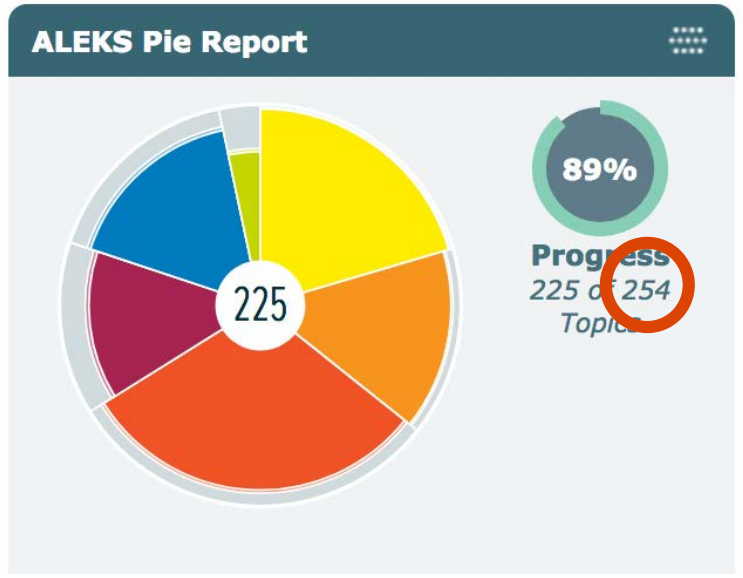
Average Initial Knowledge Check:
24%

Fall 2017

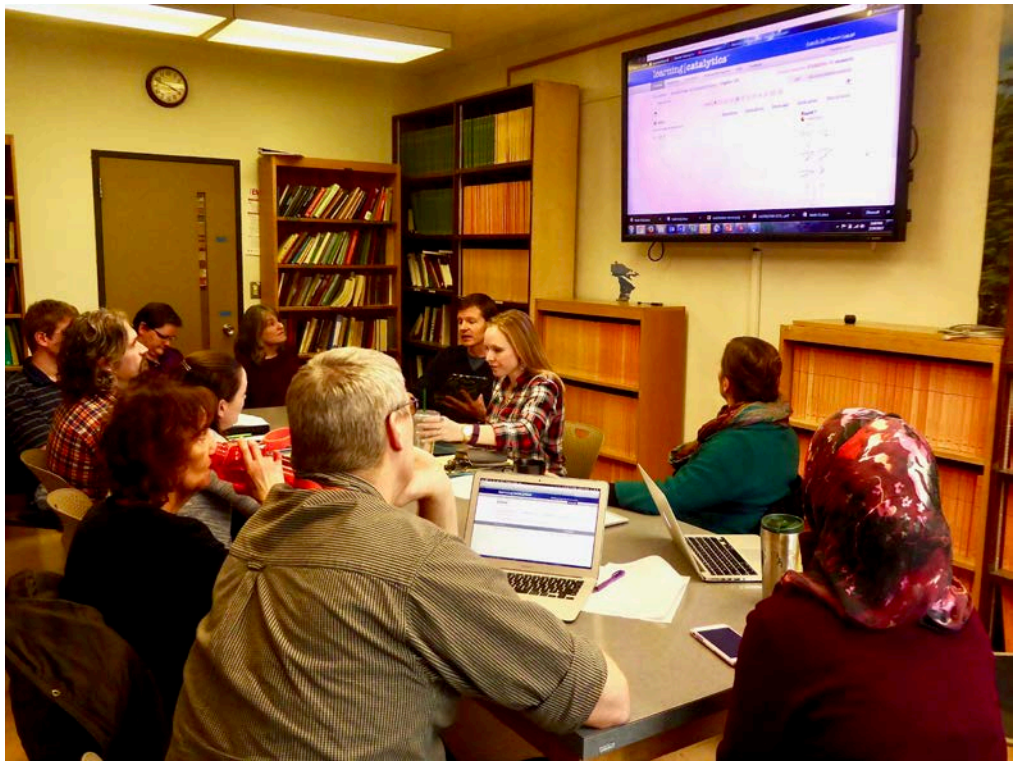


Average Initial Knowledge Check:
28%

Winter 2018



Average Initial Knowledge Check:
39%



Adaptive and Active In Class: Learning Catalytics

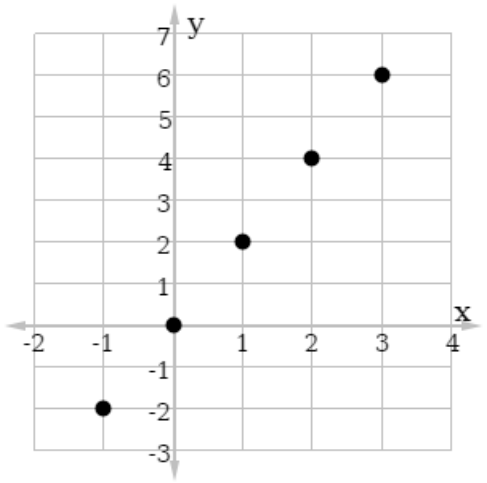
Learning Catalytics

- Traditional lecture replaced by an increase in active learning
- Facilitate group and whole class discussions
- Adapt instruction in real time, based on student responses
- Students can log into a session with any Wi-Fi enabled device

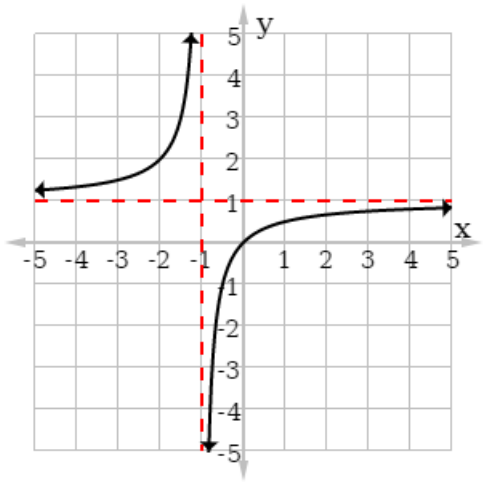
An Example of a Multiple Choice Question with Grouping

- Question: Which of these graphs represents y as a function of x?

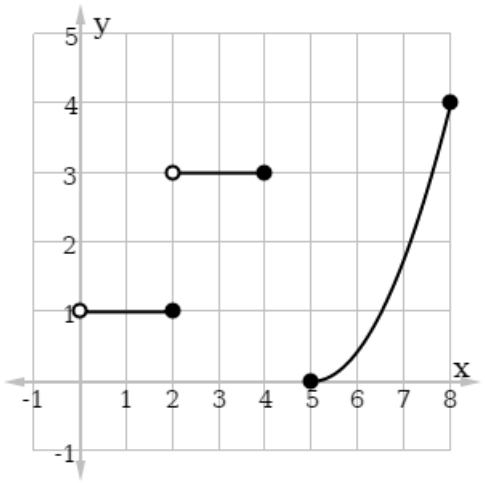
A



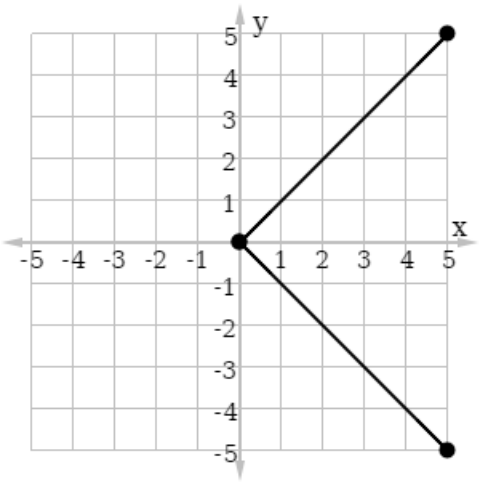
B



C

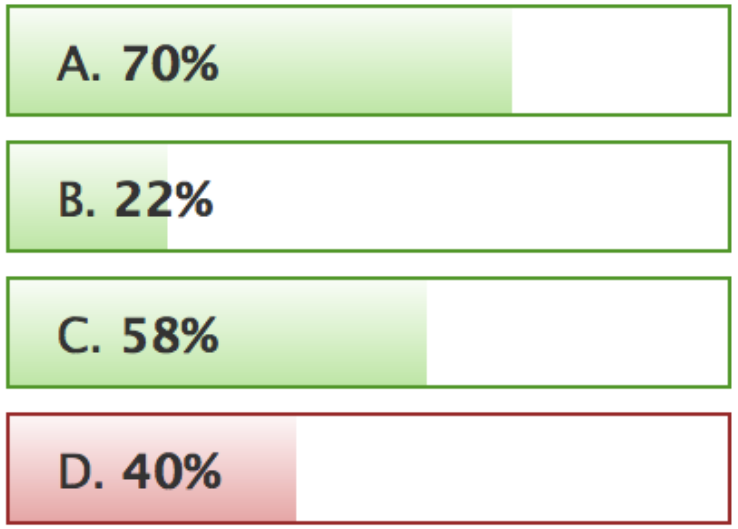


D

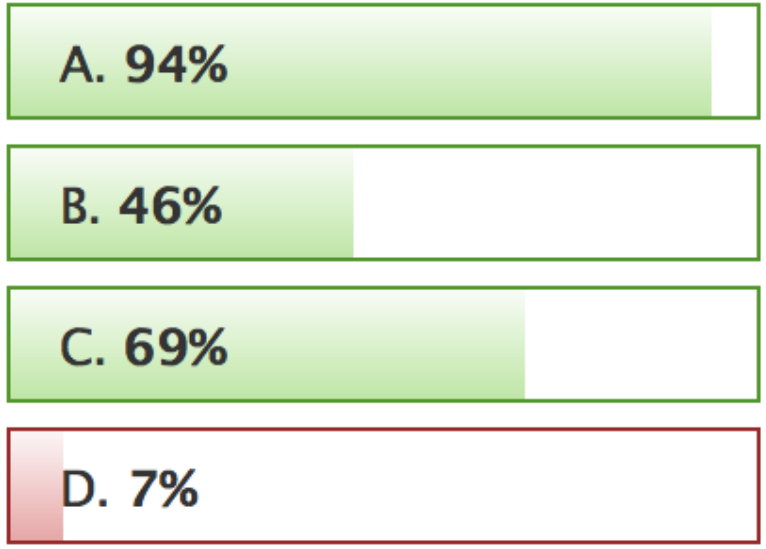


Student Responses

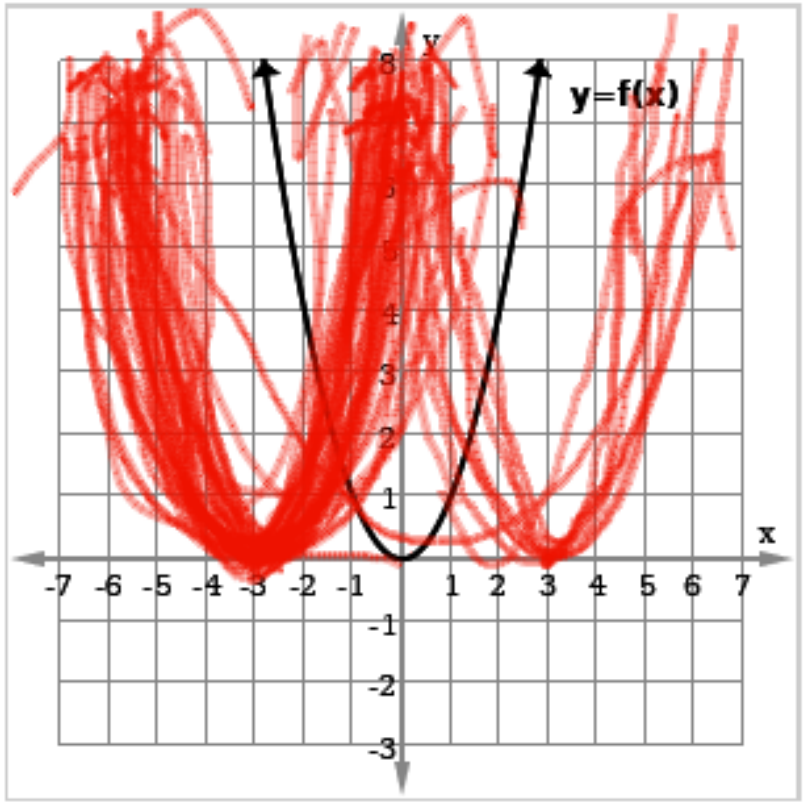
Before Grouping



After Grouping



Sketch a graph of $g(x) = (x + 3)^2$



18 Learning Catalytics Question Types

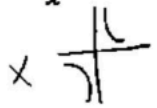
- Composite sketch
- Confidence
- Data collection
- Direction
- Expression
- Highlighting
- Image upload
- Long answer
- Word cloud
- Many choice
- Matching
- Multiple choice
- Numerical
- Priority
- Ranking
- Region
- Short answer
- Sketch
- Slide

Student Experience!

Handout

- Student responses to question 4) on handout
- Student work

7) (5 points) Which of the parent functions have even symmetry (symmetric about the y-axis)? Bubble all that apply.

○ $f(x) = \frac{1}{x}$ 

● $f(x) = x^2$ 

○ $f(x) = \sqrt[3]{x}$ 

○ $f(x) = x$ 

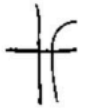
● $f(x) = |x|$ 

○ $f(x) = e^x$ 

○ $f(x) = \sqrt{x}$ 

● $f(x) = \frac{1}{x^2}$ 

○ $f(x) = x^3$ 

○ $f(x) = \ln(x)$ 

Additional Keys to Success

Rigorous Course Coordination

- Course coordinators
- Master LMS Site
- Master Learning Catalyics Course
- Master ALEKS Template
- Weekly coordination meetings
- Identical syllabi
- Common exams and common grading

Course Structure

- 4-credit face-to-face
- Two 1 hour 50 minute classes per week
- Class sizes range from 20 – 200
- Active learning classrooms
- GTAs and LAs

Data!

Improvements in DFW Rates

They improved! Unfortunately, we do not have permission to share these publically. Please contact us if you would like more information.

What’s Next?

Future Plans

- Continue assessing student success in courses currently using ALEKS
- Continue to adjust and adapt our ALEKS courses
- Creating an online course for Algebraic Reasoning using ALEKS
- Redesign Elementary Functions/Pre-Calculus using ALEKS
- Continue to add more robust Instructor Resources to our courses.

QUESTIONS?

Oregon State University

Sara Clark

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- Instructor, Academic Advisor and Course Coordinator in the Oregon State University Mathematics Department
- 20 years of experience teaching developmental math through calculus and curriculum development
- 4 years of experience teaching with adaptive course ware in online and face-to-face courses
- Coordinator of new Learning Assistant Program in mathematics department

Katy Williams

Katy.Williams@oregonstate.edu

- Instructor and Course Coordinator in the Oregon State University Mathematics Department
- Masters of Science, Statistics
- Coordinator of new Learning Assistant Program in mathematics department
- Involved in the intense redevelopment of three courses implementing adaptive course ware and increasing active learning
- Re-developed online College Algebra to increase student engagement