Hands-On Precalculus: Modeling and More!

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The School: Glendale Community College

- 15,843 Full Time Equivalent Students
- 17% Caucasian/European/Anglo
- 32% Caucasian/Armenian
- 31% Latino/Hispanic
- 9% Asian/Pacific Islander
- 5% Filipino
- 3% Black/African American
Math 101
(Intermediate Algebra)

Math 110
(Precalculus)

Math 110A (Precalculus I)

Math 110B (Precalculus II)

Math 103
(Calculus I)
Math 110: Precalculus

- 6 lecture units
- Meets 6 hours per week
- Success Rate: 50.1%
- Retention Rate: 69.3%
- Prerequisite: Intermediate Algebra
Math 110A: Precalculus I

- 3 lecture units and 0.5 lab unit (lab units are 1:3 :: units:hours)
- Meets 4.5 hours per week
- Success Rate: 54.8%
- Retention Rate: 72.9%
- Prerequisite: Intermediate Algebra
Old Sequence

- Math 100 - College Algebra
  - 3 units, meets 4 hours per week

- Math 102 - Trigonometry
  - 3 units, meets 4 hours per week
  - Non-transferable

- Math 103 - Calculus I
Why the need for the lab component?

- CA required units and hours to match (i.e. 3 unit lecture class should meet 3 hours per week)

- Saw an opportunity to have students explore concepts using active and cooperative learning without adding significantly more units and cost.

- To keep Math 110A at 4.5 hours per week with 3.5 total units, we needed to utilize lab units
What do we do with the extra time?

- More in-depth explanations and examples
- Active Learning
- Mathematical Modeling: through lab activities
“...we call on institutions of higher education, mathematics departments and the mathematics faculty, public policy-makers, and funding agencies to invest time and resources to ensure that effective active learning is incorporated into post-secondary mathematics classrooms.”

- CBMS Statement, July 2016

Conference Board of the Mathematical Sciences made this statement and is signed by a multitude of professional math organizations including AMATYC, AMS, ASA, MAA, NCTM, SIAM.
Math Research Project

- Funded by Title V
- 12 labs for Math 110A
- 8 labs for Math 110B
- Quasi-experimental study in Fall 2017 to measure effectiveness of lab activities
  - 4 Math 110A courses are being offered; 2 control and 2 treatment
  - Both treatment classes are held in computer classrooms
- Data Collection:
  - Pre/Post Tests
  - Qualitative Survey
  - Success Rates
  - Retention Rates
- The collection of labs will be made available to all math faculty with training provided.
Time Line:

- Summer 2016 - Researched mathematical modeling and active learning

- Fall 2016/Spring 2017 - Discussed which topics would benefit from increased exploration by students and started writing labs/rubrics/evaluation techniques

- Summer 2017 - Agreed on measurable goals for treatment classes vs control classes

- Fall 2017 - Implementation of labs into treatment classes
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Lab 1: An Introduction to Mathematical Modeling

When is using Uber or Lyft less expensive than owning a car?

Motivation:
Mathematical modeling is often a messy and iterative process. Usually a simple model is developed with clearly stated assumptions and then more complexity can be added into the model.

Students:
• come up with assumptions
• decide what the variables are
• research what it costs to own a car
...despite the usefulness and value in demonstrating how mathematics can help analyze and guide decision making for real world messy problems, many people have limited experience with math modeling.

GAIMME - Guidelines for Assessment & Instruction in Mathematical Modeling Education

Joint publication from the Consortium for Mathematics and its Applications (COMAP) and the Society for Industrial and Applied Mathematics (SIAM)
Lab 3: Absolute Value Equations and Inequalities

Motivation:
There are several methods to solve solutions absolute value inequalities. By “seeing” the interval(s) containing solutions to inequalities of the form $|x| \leq a$ and $|x| \geq a$, translations can be used to easily solve inequalities of the form $|x-c| \leq a$ and $|x-c| \geq a$. 
Lab 7: Polynomial Function Graphing
Polynomial Function Graphing
Math 110A Lab – Student Worksheet

Name ____________________________

Directions: For each graph, write a function for the given graph in both factored and expanded form.

1. Factored form: $f(x) =$ _____________
   Expanded form: $f(x) =$ _____________

2. Factored form: $f(x) =$ _____________
   Expanded form: $f(x) =$ _____________
“To ensure students graduate with skill sets to match expectations of prospective employers, our community must modernize curricula with input from representatives in partner disciplines, business, industry, and government.

A Common Vision for Undergraduate Mathematical Sciences Programs in 2025

A Common Vision is a joint effort, focused on modernizing undergraduate programs in the mathematical sciences.

Signed by AMATYC, AMS, ASA, MAA, and SIAM.”
Lab 9: Dissolving the Taj Mahal in Acid Rain

- Collaborated with a chemistry instructor from Glendale College
  - You’d be surprised about how willing instructors are to collaborate about math topics. Ask around your campus!

- Students performed an experiment to determine the rate law for a chemical reaction.

- It took some coordination with our chemistry department to find a suitable day to borrow a lab classroom.

- Equipment needed:
  - Analytical scales (accurate to three decimal places)
  - Marble chips and HCl acid
  - Glassware
  - Goggles and gloves
Lab 9: Dissolving the Taj Mahal in Acid Rain

- The experiment consisted of dissolving marble chips in hydrochloric acid and measuring the mass loss over time.
  - Students do the experiment in a chemistry lab (30 minutes)

- The analysis and mathematical modeling were done in class during the next session. (90 minutes)
  - Took some time in class to teach some basic MS Excel skills

- In small groups, students determined the order of the reaction and found that it was most appropriate to use an exponential decay model.

- Once students had their model, had to answer a follow-up question for homework:
  - How long would it take for the Taj Mahal to dissolve in acid rain?
What’s next?

- Plan for Math 110B, pilot in the Spring semester
- Possibly write more labs connected to different partner disciplines
  - Biology
  - Physics
  - Engineering
- Make labs available to all instructors
- Instructor training
- AMATYC 2018 Orlando - quasi-experimental study results
Digital/Editable Copies:

www.glendale.edu/precalculuslabs
Questions?

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