

MAKING QUANTITATIVE REASONING CENTRAL TO A PRE CALCULUS COURSE

Cinnamon Hillyard
Nicole Hoover
University of Washington Bothell

BACKGROUND

- In 2006, UWB started its lower division program. We had the opportunity to build our freshman math courses from scratch.
- UWB has a strong foundation/learning goal of QR with it's QSC started in 2000.
- Limited resources and student pool meant we had to have a course that would do double duty: prepare students for calculus AND provide significant QR experience.

FUNCTIONS, MODELS, AND QUANTITATIVE REASONING (FMQR)

- FMQR is a 5 credit, 10-week course
- Students place between 40% and 70% on our QR math placement exam to get into FMQR.
- Textbook: "Functions Modeling Change" by Connally, et al.
- We cover the general concept of function including average rate of change, domain/range, inverses, intercepts, and composition. We focus on Linear, Exponential, and Sinusoidal mathematical models.
- QR is purposefully integrated into all forms of student work including homework, labs, two midterms, comprehensive final, and in-class work.

SAMPLE IN-CLASS ACTIVITIES

Typical day... (125 min)

- Answer questions,
- Brief introduction to key topics,
- Worksheet with 2-5 contextual problems
- End with a review of the "big" ideas learned.

The population of King County was approximately 1.5 million in 1990. The 2000 Census reported the population to be 1.7 million. Let the population, P in millions be a function of t , time in years after 1990.

- Find a linear equation to model the population growth.*
- Find an exponential equation to model the population growth.*
- Use both models to predict the population in King County in 2050.*
- Which model is growing faster? Discuss with your group situations in King County which might make the exponential equation or linear equation a better model.*

ALMOST WEEKLY LABS

<p>Introduction to Excel: Census data and marriage rates over time.</p> <p>Linear functions: Blood Alcohol Concentrations Body parts*</p> <p>Exponential functions: Koch snowflakes Short-term loans Radon poisoning*</p>	<p>Trigonometric functions: Daylight hours* Romantic cycles*</p> <p>Review labs: Concept maps of mathematical function topics Learning styles and studying mathematics Everything else: extending concepts to a general function.</p>
--	---

*These labs were adapted from University of Arizona's pre-calculus course.

HOW LABS ELICIT QR

- All labs are based on real world issues with real data.
- Students hand in word-processed answers with complete sentences including well-designed graphs and tables from Excel.
- Students make decisions or hypothesis before calculating anything and then revisit those decisions after doing the math.
- Students think about, analyze, and write about what they are computing.
- Often, students generate and compare two or more models with different assumptions
- Often, students investigate a small research question that follows up on the mathematics.

CHALLENGES

- Creating meaningful **writing** and other **reflective** assignments getting students to recognize what they are doing as QR. (Tried autobiographies, reading and responding Math & Democracy, and online discussions.)
- Adaptability of course by instructors hired to teach one section of the course.
- Grading and scalability to larger class sizes
- Getting students to see it not as a repeat of high school – maybe they haven't done this all before?

STUDENT FEEDBACK: COURSE LED TO QR

Movement to “understanding”:

- I'm actually understanding all of this, even though I studied it all last year.
- I feel like they [logarithms] meant nothing to me when I was just plugging them into the calculator but now I actually feel like I know what I'm putting into the calculator and why it's giving me the answer it's giving me.

Excitement about “applying”:

- Learning about the third type [periodic] of function was very confusing to me when I first learned about them. But with the real life examples we have been using to learn how they work has helped me a lot to understand.
- I, of course, knew that there was math all throughout the world, but doing these labs has helped point out certain examples. And now every once in awhile, I look at a situation and wonder, what would Cinnamon ask?

STUDENT FEEDBACK: QR DEEPENED MATH UNDERSTANDING

Learning about learning math:

- In high school I was very used to doing everything on my own, but now, since during every class period we have to work in groups, I've been exposed to a completely different learning style in math. At first it was a challenge since I wanted to work at my own pace, but in the end I think it'll help me because it forced me to understand where everyone else is coming from. Also, being able to explain a concept verbally means that I know the topic well; and if I can't help my classmates, then I know I have some studying to do!
- I learned that the best way to learn math is by doing it right after the concept is introduced. For example, professor cinnamon introduces a new chapter with new concepts and formulas, after spending time in class she puts us in groups so we can try it out.

Multiple representations of mathematics:

- I would say the most interesting things that I've learned throughout the quarter was that there are a variety of ways you can demonstrate math concepts or a set of data. For instance, you can use a graph, table, equation or even doing a DANCE =]