Session 278:

Building Conceptual Understanding with Scenario-Based Tasks

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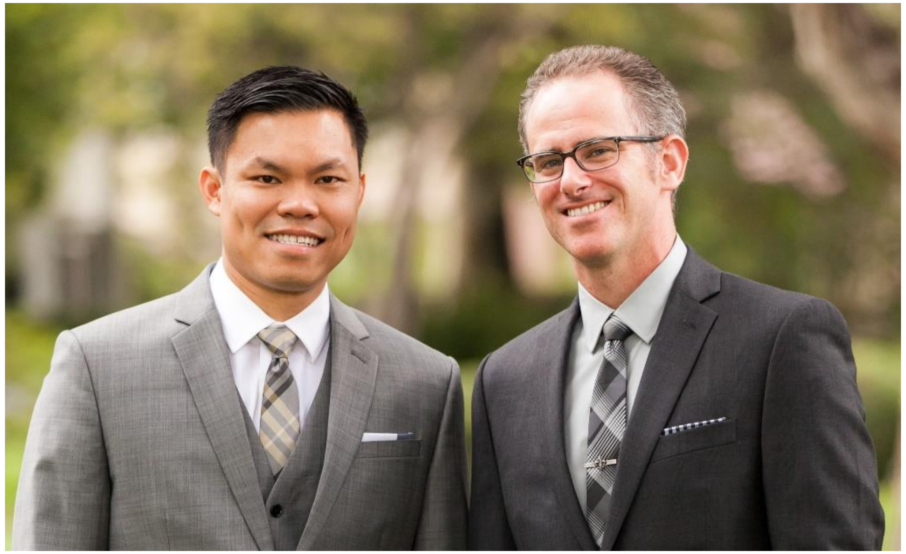


- Attended UCLA for Undergraduate and Graduate School
- Teachers at Orthopaedic Medical Magnet High School in the Los Angeles Unified School District.
- National Board Certified Teachers
- Park City Math Institute 2013, TwitterMathCamp2015
- Master Teacher Fellows for Math for America Los Angeles
  - <u>Project Title</u>: *Creating and Implementing a Pathway to Calculus via Common-Core Aligned Curriculum*

Why We're Here

- We have a "Pathway to Calculus" project with Math for America.

- Designing a 3-year, functions-based, Common Core aligned curriculum with the AP Calculus Exam as one of the end goals.
  - Year 1 Pre-Calculus (Algebra 2)
  - Year 2 Pre-Calculus (Trigonometry and Math Analysis)
    - Year 1 and 2 will have covered all of CCSS HS Standards except Statistics and Geometry.
  - Year 3 AP Calculus AB/BC

- Our students are enjoying the curriculum we are implementing. So we want to share it with others.

Year 1 Progression

*Unit 1: Relations and Functions

- Unit 2: Linear and Piece-wise Linear Functions
- Unit 3: Arithmetic Sequences and Series
- Unit 4: Quadratic Functions
- Unit 5: Exponential Functions
- Unit 6: Geometric Sequences and Series
- Unit 7: Equations
- Unit 8: Operations on Functions

Unit 1: Relations and Functions

- Common Core Standards:
  - F-IF 1, 2, 4, 5, 6
  - N-Q 1, 2, 3

Key Vocabulary ➔

Set
Relation
Function
Graph
Mapping
Ordered Pairs
Table
Input
Independent Variable
Domain
Output
Dependent Variable
Range
Interval

Interval Notation
Set Notation
Function Notation
Vertical Line Test
Discrete
Continuous
Maximum
Minimum
Increasing
Decreasing
Average Rate of Change
Instantaneous Rate of Change
Position Function
Velocity

Task 1.8 Connecting the Dots (or Not)

- Previous Tasks have addressed:
  - Relations and Functions
  - Domain and Range
  - Different ways to represent relations: Table, Graphs, Mapping, Ordered Pairs
  - Set / Interval Notation

- This task:
  - Revisits concepts from previous tasks
  - **Focuses on Discrete vs. Continuous Functions**

- Consider:
  - Does this task have a place in your curriculum?
  - How/when would you use this in your class?

Goals of our Curriculum

- Common Core aligned
- Long-Term goal of success in AP Calculus
- Composed of scenario-based tasks
- “Spiraling” mathematical concepts
- Encourage productive struggle
- Focus on conceptual understanding
- Strive for coherence in sequencing
- Make use of mathematical vocabulary and notation
- Emphasis on functions
- Multiple entry-points, open middle, multiple perspectives

Task 1.10 Double Mata-thon

- <u>Previous Tasks have addressed:</u>
  - Relations and Functions
  - Domain and Range
  - Different representations: Table, Graphs, Mapping, Ordered Pairs
  - Set / Interval Notation
  - Discrete vs. Continuous Functions

- <u>This task:</u>
  - Interpret data from a table
  - **Introduces function notation**
    - Name function
    - Write equations for the function
    - Relate input and outputs in a way that is easy to communicate

- Consider:
  - Does this task have a place in your curriculum?
  - How/when would you use this in your class?

$$f(x)$$

What is a Scenario-Based Task?

- Tasks are launched using a ‘real/fake world’ scenario that creates need for math content we want our students to learn
- Begin with questions that help student understand the scenario
- Include one or more essential questions that will encourage students to think critically and make new connections/discoveries
- Include follow-up questions so that students can apply their learning, cement their understanding, and/or extend what they have discovered throughout the lesson.
- Emphasize literacy and vocabulary

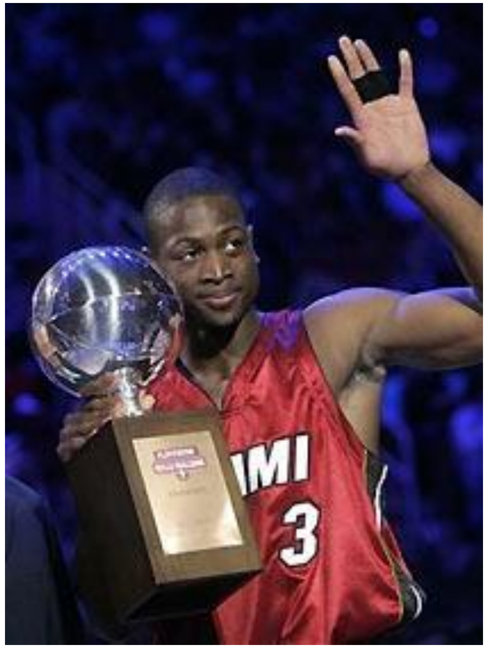
Why Scenarios?

- Provides context for content
- Scenarios promote engagement and curiosity through cultural relevance
- Organically create need for content
- Promote discussion and collaborative learning
- Promote sense making
- Students can justify their answers in the context of the scenario
- Encourage transfer of knowledge to other contexts

1.11: Dwayne Wade Signals Hello from a Distance

- Previous Tasks have addressed:
  - Relations and Functions
  - Domain and Range
  - Multiple representations
  - Set / Interval Notation
  - Discrete vs. Continuous Functions
  - Function notation
  - Maximum / minimum

- This task addresses:
  - Interpreting data from a table
  - **Introduces average rate of change**
  - **Emphasize difference between continuous and discrete**



Implementing Tasks

Lesson Approach:

1) Launch

Introduce Scenario through story, picture, story, or combination of these things

2) Investigate

Students work on task in groups while teacher circulates

3) Debrief

Whole class discussion of certain/questions of the task

Individual students share their answers

Teacher use a students' paper and elicit responses from classmates

Unit 1 Exam: Part 3

- Part 1: Students sketch the graph of a given scenario, write story that matches their graph, then answer questions based on their specific graph & story.
- Part 2: Students fill out a table of values and graph based on information about a scenario.
- **Part 3: Given a graph that matches a scenario, students answer questions about the function.**
  - Interpret data from a graph
  - Focus on **solving equations graphically** (when the output is given, what is the input?)
  - Answer questions and justify using the scenario
  - The graph foreshadows Unit 2: Linear and Piecewise Linear Functions
- Part 4: Given a scenario, students determine whether or not it is a function.

Near Transfer vs. Far Transfer

Transfer of Learning is the application of skills, knowledge, and/or attitudes that were learned in one situation to another learning situation (Perkins 1992).

- NEAR Transfer: Skills and knowledge are applied in the same context as they were taught.

- FAR Transfer: Skills and knowledge are applied in an entirely different context from the one in which they were taught.

- Our compromise: MEDIUM Transfer

Medium Transfer (our definition)

- Within the same context but requiring a different type of thinking (i.e. thinking backward).
- In a different context with similar questioning, vocabulary, and procedures.
- In the same context but requiring additional knowledge/skills not directly addressed in the lesson.
- New lines/types of questioning in every task.

Productive Struggle

At NCTM 2015 we heard a lot about "Productive Struggle."

- The intellectual effort students expand to make sense of mathematical concepts that are challenging but fall within a student's reasonable capabilities.

- Struggling to make sense of mathematics is a necessary component of learning mathematics with understanding.

- **Scenarios allow students to be more PRODUCTIVE as they STRUGGLE as they are able to grasp the math content in context of the scenario.**
    - This avoid the need for students to rely on the teacher and be more in accountable for their own learning and understanding.

- We have also increased Productive Struggle by flipping our tasks to remove scaffolding questions and present students with only Essential Questions. (See Task 1.4: The Mountain Doozy)

What we think about when CREATING and IMPLEMENTING any task…

- Content
  - What do we want students to understand?
  - What skills do we want students to develop?
  - What vocabulary should they be able to recognize and/or use?
  - How can we model the math? What does the graph look like?

- Engagement
  - Providing Relevant Context has been key for us.
  - Exploring the context provides variety, motivation, and entry points.
  - Differentiation with differing levels of questioning, scaffolding, and *Extensions*
  - Establishing Rigor and being "Less Helpful"
  - Avoiding a "Cookbook" line of questioning
  - Focusing on Far and Medium Transfer

Questions? Comments?

https://www.youtube.com/watch?v=RkjdEIe6Ap8&feature=youtu.be

Send your text message to this Phone Number: 37607

poll code for this session

161571 *(1 space)* ____ ____ ____ *(1 space)* ______________

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Speaker was engaging and an effective presenter (0-3)

Speaker was well-prepared and knowledgeable (0-3)

Session matched title and description in program book (0-3)

Other comments, suggestions, or feedback (words)

Example: **161571** 323 Inspiring, good content

Non-Example: **161571** 3 2 3 Inspiring, good content

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