Engaging Students in Constructing Mathematical Understanding
About me

Thanks also to my daughter Chantale for helping with the images!
Take Care of Your Needs!

... and use the Notes Sheet if it helps your learning
Hand Raise Signal

Photo Source: elearningchips.com
About you!

Table Groups: Introduce yourselves ... and what you hope to gain from this workshop!
Our Agenda Today

Welcome
Warm-up activities
Sample lesson
Eliciting principles and strategies
Closing

Photo Source: www.bluebeetle.me
Four Styles of Math Students: what they want

Mastery: Practical information and set procedures

Understanding: Understand why the math they learn works

Interpersonal: Learn math through dialogue, collaboration, and cooperative learning

Self-Expressive: Use their imagination to explore mathematical ideas
Four Styles of Math Students

Mastery / Understanding / Interpersonal / Self-Expressive

Photo Source: iconarchive.com
What we already know: Table posters

What are some of the strategies you know or have used that help students build their understanding of mathematics?

Make a poster at your tables!
What we already know: Gallery Walk

Photo Source: flipkey.com
What is Mathematics?

Discuss at your tables!
One Possible Definition of Mathematics

Math is the science of patterns:

Describing, Representing, Discovering, Investigating, Creating **Patterns**

- Numerical, Algebraic, Graphical, Real-world **patterns**

God has created a universe full of patterns

God has created **us** with the capacity to detect, enjoy, and create patterns
One Possible Definition of Mathematics

Math is the science of patterns:

Describing, Representing, Discovering, Investigating, Creating, Applying **Patterns**

If this is true, what might be important about how students learn, do, and understand mathematics?
Learning Outcomes

- Understand through experience and reflection some of the principles and strategies that can help build student understanding (With a focus on guided investigations)
- Consider some shifts in identity that teachers may need to undergo in order to effectively facilitate constructivist learning
Sample Math Lesson - Introduction

During this sample lesson, imagine that you are a student who does not already know all of these concepts.

I will hear lots of talking as groups discuss, explain, and make sure everyone has a voice and no-one is left behind.

Feel free to send “spies” to consult with other groups if needed.

Feel free to ask the workshop leader for clarification.
Sample Math Lesson - Investigation

In your table groups, work on pages 1 & 2 of the investigation:

Page 1: Scenario A
Page 2: Scenario B & Follow-up Questions
Sample Math Lesson - Debrief

Whole group sharing about Follow-up questions
Sample Math Lesson - Categorization

Now proceed to Page 3:

Categorizing and Classifying Sequences A - F
Sample Math Lesson - Terminology

Arithmetic Sequences (B, D, F)
B: +20  D: +3  F: + (-6)  (Please label!)

Geometric Sequences (A, C, E)
A: x2  C: x3  E: x 0.1 (or x 1/10)  (Please label!)

Write your own definition of “Arithmetic Sequence” and “Geometric Sequence”
Sample Math Lesson - Learning Goals

- Understand what Arithmetic and Geometric sequences are.
- Be able to identify Arithmetic and Geometric sequences.
- Be able to create examples of Arithmetic and Geometric sequences ... including real-world examples.
Sample Math Lesson - Identifying sequences

37, 45, 53, 61, ...

*How can we decide which type of sequence this is? Discuss at table groups*

45-37 = 8; 53-45 = 8; 61-53 = 8 The “Common Difference” is 8. This is Arithmetic (+8)
Sample Math Lesson - Identifying sequences

3, 12, 48, 192, ...

How can we decide which type of sequence this is? Discuss at table groups

$12 \div 3 = 4$; $48 \div 12 = 4$; $192 \div 48 = 4$. The “Ratio” is 4. This is Geometric (x 4)
Sample Math Lesson - Write a procedure

At Table Groups: Write a procedure for “testing” a sequence to decide if it is Arithmetic or Geometric (or neither)

In your procedure, use the terms “common difference” and “ratio” if possible
Sample Math Lesson - Pairs Practice

Individually:

Create a sequence that is either Arithmetic or Geometric. Do not label it.

Swap with a partner and identify which kind of sequence your partner created.
At your table group:

Create a real-world scenario that would produce an arithmetic or geometric sequence
De-constructing the Sample Math Lesson

At your table group:

What were some of the principles, design features, strategies that helped learners build their understanding?

Use the big paper provided

Feel free to send “spies” to other groups to gather ideas
De-constructing the Sample Math Lesson

What were some of the principles, design features, strategies that helped learners build their understanding?

What were some of the “scaffolds” that supported student learning and ensured they could get “unstuck”?

What were some of the teacher’s roles?

What might be important about the classroom culture?
Some Strategies / Design Features / Principles

Real-world “hook”

Finding and testing patterns (lots of feedback)

Using manipulatives

Multiple Representations (e.g. graph, table, words)

Social Interaction / Discussion

Creating definitions and procedures and testing them

“Reversed Teaching” (S learn / explore then T teaches)
Some Scaffolds to Support Learning

Real world scenario

Instructions *(guided investigation)*

Students have some control of pace; re-reading

Support and feedback from each other

Teacher monitoring and supporting

Procedures that students develop
Teacher Roles / Moves

Foster a culture of safety, collaboration, risk-taking

Designing, preparing (task, instructions, materials)

Monitoring, check for understanding, assisting or adjusting as needed

Provide opportunities for practice.

Ensure clear take-aways / procedures
Quick Overview of Another Example Lesson: Multiplying Fractions

We all know how to multiply fractions

E.g. \( \frac{7}{8} \times \frac{5}{6} = \)

\[ \frac{35}{48} \]

\( 7 \times 5 = 35; \quad 8 \times 6 = 48 \)

BUT WHY?
Multiplying Fractions Modeling / Investigation

Page 2: Review Rectangle Model of Multiplication

Page 3: Review Fraction Models

Pages 4-8: Students explore a Rectangle Model for multiplying fractions

Page 9: Pattern-finding, Rule-making

Follow-up: Practice
Multiplying Fractions Lesson Debrief

What helps build understanding here?

- Visual models
- Manipulatives
- Pattern-finding
Closing Thoughts and Encouragement

- Shift in identity → “Designer of learning experiences that build student understanding”
- Multiple approaches
- Experiment and adjust!
  - You may be new at it
  - Your students may not be used to it

Photo Source: www.marsitraining.com
3 - 2 - 1

3 things that stand out to me

2 things I can visualize myself trying with my class

1 thing I will share with a colleague

Journal, and discuss