Making Math

MathWeave Group

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Challenges

- **As teachers,**
  - **We have so many needs in the classroom, that even in the early years there are multiple starting places for students in math.**
  - **We also see students struggling with math but cannot get them to see what we need them to see.**
  - **We also have students racing ahead in math and few consistent ways to challenge them.**
  - **And, sooner or later, all teachers come to this question:**

    - **When will we ever use this?**

MathWeave

- **As a research group**
  - **We are interested in new approaches to mathematical and artistic creation**
  - **And along the way, pose new solutions to the question,**
    - **"Why are we learning this?"**

MathWeave

- **Especially in weaving….**

The Analytical Engine weaves algebraic patterns,
just as the Jacquard loom weaves flowers and leaves.

Ada Lovelace (1815-1852)

In our group, we talk a lot about what math is…

- **Utilitarian. It is good for us.**
- **Knowledge is easily measured**
- **About numbers, operations and formulae**
- **Procedural**
- **About analysis**

- **But it is also…**
- **Impractical and esoteric**
- **Process based**
- **Looking to express the unknown and unknowable**
- **About experimentation**
- **About making**

Why Making is Essential

- **When students touch and make objects that they care about, it answers the age old question**

"Why are we learning this?"

- **We offer multiple ways of making and responding to making so we can be sure that learning is taking place**

Why Making is Essential

- **Making, tinkering, experimenting and posing interesting questions:**
  - **is the kind of math that solves new problems, invents new applications, finds varieties of forms and, sometimes, invents new math.**
  - **includes more kids.**
- **Making, especially weaving has many ways for students to approach it, and many ways for them to go *deeply* into it.**
- **All they have to do is to learn to change things, observe what the changes do …**
- **Like in art. Like in weaving. Then they own the math.**

Variables and Change

- **The simple concept of 'variable', the idea that there is something that can be changed and that change affects other things, is a key concept for us.**
- **When you change something, and examine the change, you are on the verge of doing math; look closely and you will see the math.**
- **Consider the mathematical formulations**
  - **if you bend, twist, flatten, shrink, expand, copy, distort, flip, rotate, reflect, cut among many possibilities.**
- **If you take one thing away from today, consider that the longer and sooner we develop the idea of a 'variable'…**

And yes, this is in the curriculum

- **From the preface to the new curriculum about the nature of mathematics:**
  - It is important for students to understand that mathematics is dynamic and not static. […] recognizing change is a key component in understanding and developing mathematics. Within mathematics, students encounter conditions of change and are required to search for explanations of that change. To make predictions, students need to describe and quantify their observations, look for patterns, and describe those quantities that remain fixed and those that change.
  - Many important properties in mathematics and science relate to properties that do not change when outside conditions change. Some problems in mathematics require students to focus on properties that remain constant.
  - Mathematics is about recognizing, describing, and working with numerical and non-numerical patterns. Patterns exist in all strands, and it is important that connections are made among strands.

Patterns

- **We use math in patterns and every teacher has done activities that encourage pattern making and pattern seeking.**
- **Every teacher knows that patterns are found everywhere- art, science, music, dance- every human endeavour.**
- **Our goal is to show that you can take the pattern making and pattern seeking that all of you do even further.**

Making with Rigour

- **It is not enough to make cool things. We have to make with rigour.**
- **Students have to be accountable for what they make and how.**
- **Making with rigour will not likely be the same for all students.**
- **Multiple entry points, multiple ceilings.**

Assessing Making with Rigour

- Measure process as well as product
- Makers portfolios
- Framing work
- Math talk and increasingly precise talk
- Proof and proving it
- Analyze AND create mathematically

There are at least 9 ways to start making and analyzing with math

- Start with
  - the math
  - a math concept
  - a new material or method
  - a message or a use
  - a problem
  - practice/perseverance
  - a blueprint or a mindmap
  - continue a like, change a dislike
  - frame it
- End with
  - use some math
  - connect it to the math world
  - tell the procedure and method used
  - consider the message or the possible uses for what you have made
  - end with a problem
  - tally up practice/perseverance
  - end with a blueprint, recording
  - consider likes and dislikes
  - frame it