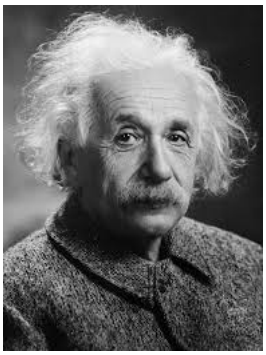
FOSTERING AN ENVIRONMENT THAT SUPPORTS LEARNING W/MATHEMATICS

ASLI, 2017

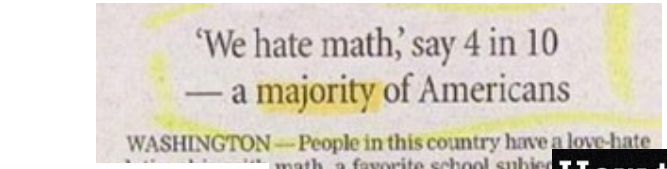
Bobbi Jo Erb

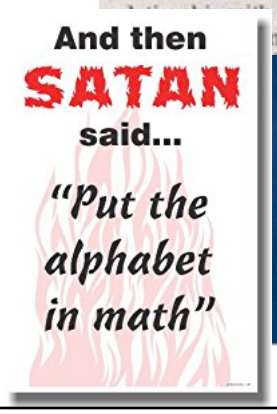
Education is not about the learning of facts, but the training of the mind to think.

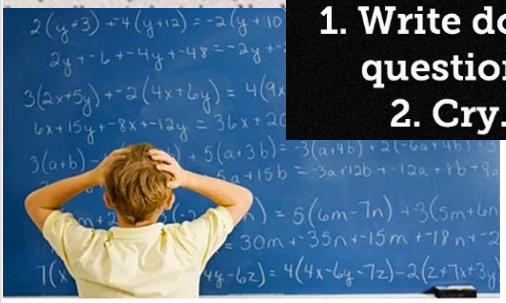


I have no special talents. I am only passionately curious.

Math has an image issue…







How to do math:
1. Write down question.
2. Cry.

Fixed Mindset

- Intelligence is static
- "Some people are just naturally good at math"
- Mistakes are evidence of unintelligence
- Praise answers

Growth Mindset

- Intelligence can be developed
- "Anyone can be good at math if they work at it"
- Mistakes are necessary for learning
- Praise process

Mathematical Mindset

- Teachers & students believe ***everyone*** can do math at high levels.
- ***Communication*** & ***connections*** are valued.
- The math is ***visual***.
- The math is ***open***.
- The environment is filled with ***wonder*** and ***curiosity***.
- The classroom is a ***risk-taking***, ***mistake valuing*** environment.

Mathematical Mindset Step #1

EVERYONE **can learn math to the highest levels.**

School & Classroom View

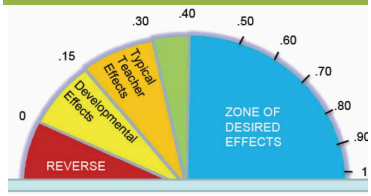
- Students are not tracked or grouped by achievement.
- All students are offered high-level work.
- Student vocalize self-belief and confidence.
- Praise is focused on effort and ideas, not the person.

Effect Sizes:

Ability Grouping- 0.12

Attitude to Math– 0.35

Feedback – 0.75



Collective Efficacy & Expectations

"When we assume that people are capable concrete things happen that translate expectations into investments of resources or effort that actually improve performance."

– Jenni Donohoo, *Collective Efficacy*, 2017

Feedback

- Must be timely, specific, understandable, and actionable
- Feedback should answer:
  - Where am I going?
  - How am I going there?
  - Where to next?
- Focused on effort & progress

4 Levels of Feedback

1. Feedback about the task
2. Feedback about the process
3. Self-regulatory feedback
4. Feedback about self

Feedback About Self

400 5th Graders took an Easy Test & Performed Well

½ of students were praised for "Working Really Hard"	½ of students were praised for "Being Really Smart"

Students were asked to take a 2nd test & choose easy or challenging.

90% Chose the harder test	Majority chose the easier test

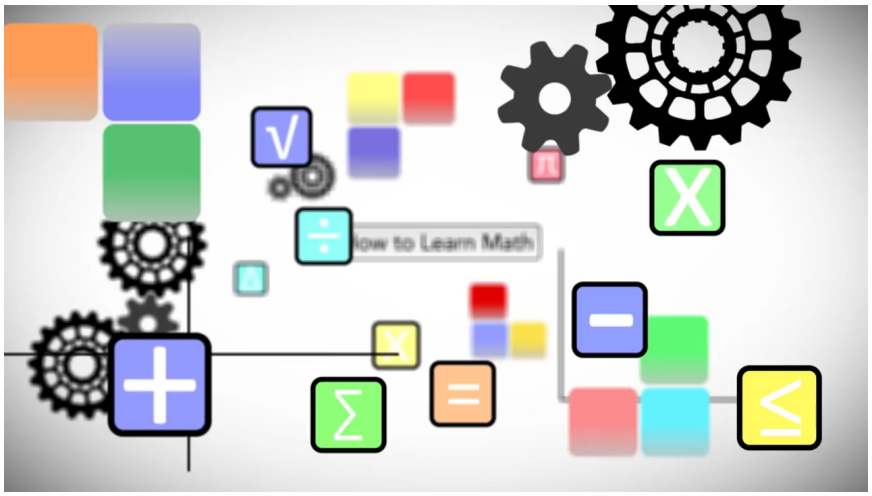
Mathematical Mindset Step #2

Mistakes are valuable.

School & Classroom View

- Students feel comfortable sharing ideas even when they are wrong
- Peers & educators seek to understand rather than correct and they work together when stuck
- Students & teachers are surrounded by positive brain/mistake messages
- Focus is on sense-making rather than answer-getting

Mistakes Grow Your Brain



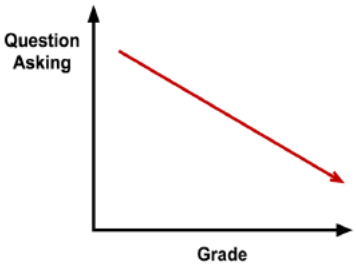
Mathematical Mindset Step #3

Questions are really important.

School & Classroom View

- Students freely ask and pose questions of the teacher and their peers.
- Questions are focused on understanding how students think about a problem and then building on that thinking (focusing rather than funneling)
- Questions from students are valued & expected

Powerful Questions to Deepen Understanding



Powerful Questions to develop a deep level of understanding

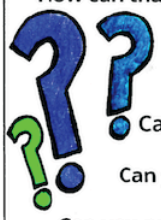
How do you see that idea?

Why does that answer make sense?

Why does that method work?

How is that method connected to others?

How can that idea be represented in different ways?



Can you prove it?

Can you prove it visually?

Can you justify your thinking?

Can you predict what would happen if....?

Did you make any interesting mistakes?

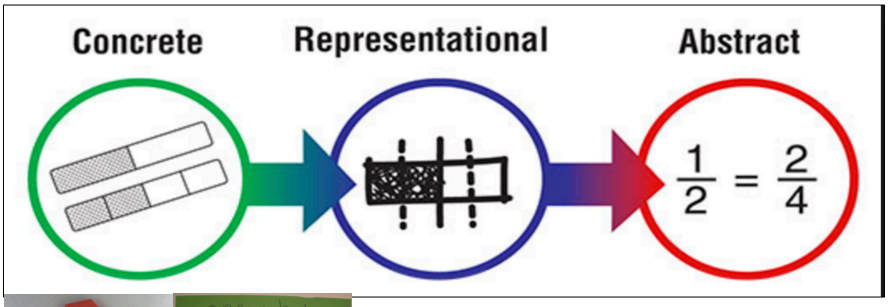
Mathematical Mindset Step #4

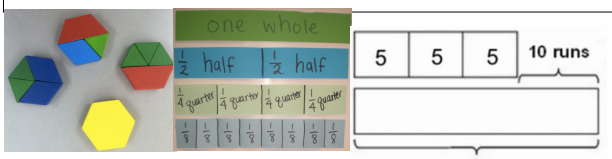
Math is about creativity and making sense.

School & Classroom View

- Teachers and students always ask "Why does that make sense?"
- Students and teachers use multiple representations of concepts and problems
- Students use and share multiple strategies & ideas for solving problems (Number Talks)
- Students see math as an unexplored puzzle

Multiple Representations





$3x - 5y = 45$

Concrete <---> Pictorial <---> Abstract

CONTEXT

What is 1 divided by 2/3?

- Try the problem using any method you'd like. Be prepared to explain your strategy. (1 min personal reasoning time)
- Share your strategy with a partner.
- As a partnership, represent this problem with a visual in at least 1 way.
- As a partnership, create a context for this problem.

Mathematical Mindset Step #5

Math is about connections and communicating.

School & Classroom View

- Students work in groups sharing ideas
- Students relate ideas to previous learning
- Students connect their ideas & strategies to their peers' ideas & strategies
- Students relate ideas to events in their lives and the world

Mathematical Mindset Step #6

Depth is much more important than speed.

School & Classroom View

- Students understand that speed isn't valued as much as deep thinking
- Timed tests are not used or are used only rarely
- Classroom discussions are not driven by the fastest students
- Procedural fluency is built from conceptual understanding

Fluency

Efficiency • Accuracy • Flexibility

"students who 'felt panicky' about math had increased activity in brain regions associated with fear. When those areas activated, decreased activity took place in the brain regions that are involved in problem solving" (Young, Wu and Menon, 2012)

Procedural Fluency from Conceptual Understanding

- **"Standard algorithms are to be understood and explained and related to visual models before there is a focus on fluency."** -- Fuson and Beckmann, 2012/13

- The early work students do with numerical reasoning strategies is related to future algebraic reasoning. **If students move too quickly to fluency work, they are far less likely to take the time to deeply understand concepts and strategies.** – NCTM's *Principles to Actions*, 2014

Mathematical Mindset Step #7

Math class is about learning not performing.

School & Classroom View

- Grades are given for learning, not performing (for representing ideas in different ways, explaining work to others, making connections, etc…)
- Fewer grades & tests …instead of grades, diagnostic comments are given whenever possible
- The focus is on sense-making rather than just answer-getting

A Culture of Mathematical Mindsets

youcubed at Stanford University

Building a Mathematical Mindset Community

Teachers and students believe *everyone* can learn maths at HIGH LEVELS.

- Students are not tracked or grouped by achievement
- All students are offered high level work
- "I know you can do this" "I believe in you"
- Praise effort and ideas, not the person
- Students vocalize self-belief and confidence

Communication and *connections* are valued.

- Students work in groups sharing ideas and visuals.
- Students relate ideas to previous lessons or topics
- Students connect their ideas to their peers' ideas, visuals, and representations.
- Teachers create opportunities for students to see connections.
- Students relate ideas to events in their lives and the world.

The maths is VISUAL.

- Teachers ask students to draw their ideas
- Tasks are posed with a visual component
- Students draw for each other when they explain
- Students gesture to illustrate their thinking

The maths is OPEN.

- Students are invited to see maths differently
- Students are encouraged to use and share different ideas, methods, and perspectives
- Creativity is valued and modeled.
- Students' work looks different from each other
- Students use ownership words - "my method", "my idea"

The environment is filled with *WONDER* and *CURIOSITY.*

- Students extend their work and investigate
- Teacher invites curiosity when posing tasks
- Students see maths as an unexplored puzzle
- Students freely ask and pose questions
- Students seek important information
- "I've never thought of it like that before."

The classroom is a risk-taking, *MISTAKE VALUING* environment

- Students share ideas even when they are wrong
- Peers seek to understand rather than correct
- Students feel comfortable when they are stuck or wrong
- Teachers and students work together when stuck
- Tasks are low floor/high ceiling
- Students disagree with each other and the teacher

Developed by Jo Boaler/Youcubed.org and Tulare County Office of Education

Mastery Experiences
Vicarious Experiences
Social Persuasion
Affective States

Collective Efficacy

Mathematical Mindsets

Questions?

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