Mathematical Mindsets in Higher Education

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Kansas Mathematics Faculty Professional Development

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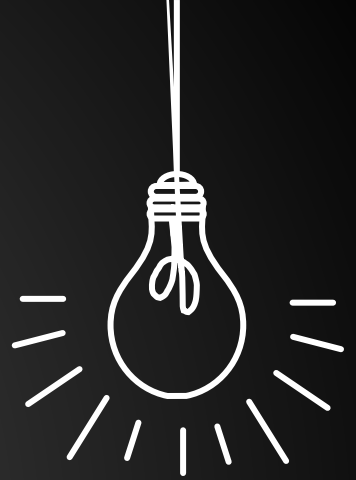
HELLO!

My name is Dr. Ashley Udell.



- Elementary Math Curriculum Coach in Kansas City, Kansas Public Schools
- Member of the local, state, and national education community
- Collaborator, author, researcher, lifelong learner

Mathematical Mindsets in Higher Education

Implicit Theory of Intelligence in Mathematics

Frustration Discomfort in Mathematics

Productive Struggle in Mathematics

Identifying Mathematical Practices

Common Core State Standards a.k.a. Kansas College and Career Ready Standards

8 Standards for Mathematical Practices

1. Make sense of problems and **persevere** in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

(KSDE, 2017)

8 Effective Mathematics Teaching Practices

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support **productive struggle** in learning mathematics.
8. Elicit and use evidence of student thinking.

(NCTM, 2014)

Learning to drive? Growth mindset required!

Theories of Intelligence Scale Survey

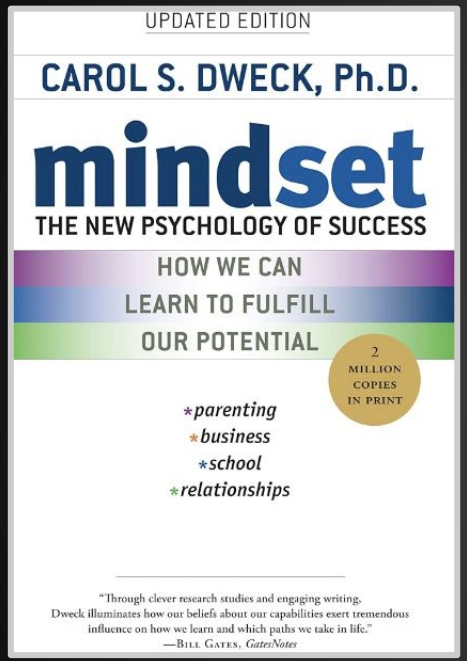
Theories of Intelligence Scale Survey
Source: Dweck, 2000, p. 156

bit.ly/4f3reQ7

Agreeing with statements #1-4 would indicate a fixed mindset. Whereas agreeing with statements #5-8 indicates a growth mindset.

- Did responses for either set of questions appear to be more sporadic or dominant than the other?
- What experiences with mathematics do you feel may have shaped your mindset?
- How does the status of your mindset affect your students' mindsets?

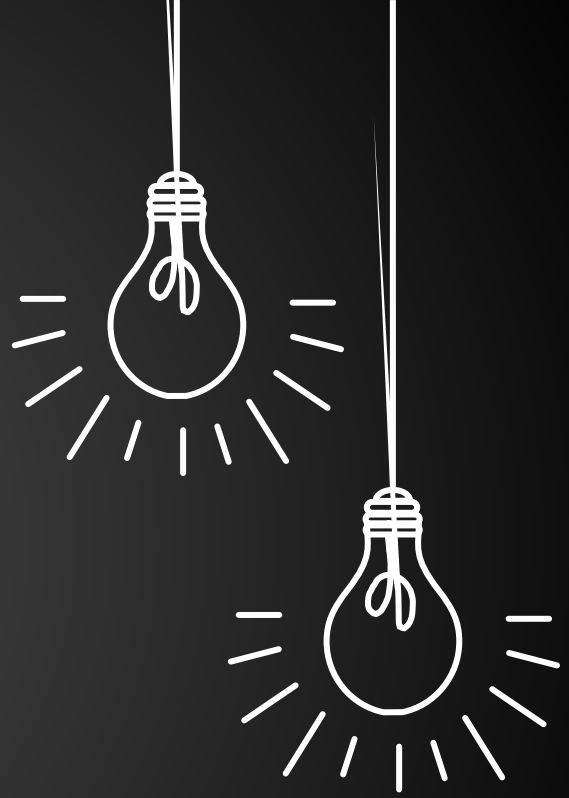
Entity



Entity Mindset
(Fixed Mindset)

vs.

Incremental Mindset
(Growth Mindset)

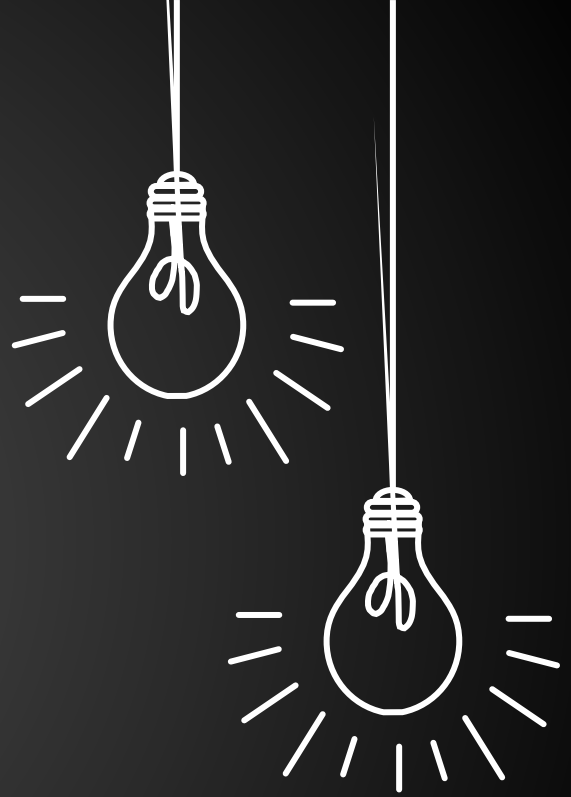


Implicit Theory of Intelligence: The Power of YET

Entity

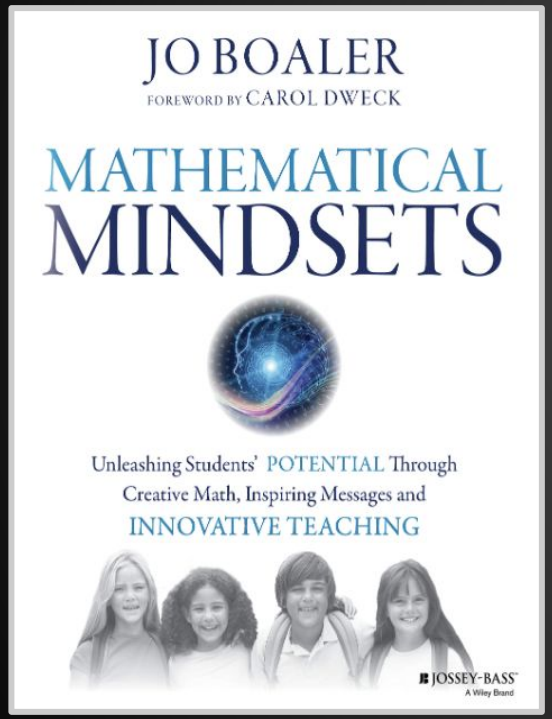
There is a mindset where people are enmeshed in their own idea of their talents and specialness, and when things go wrong they lose focus and their abilities.

It is also common for students to turn off from school and adopt an air of indifference, but we make a mistake if we think any student stops caring (Dweck 2016).



Implicit Theory of Intelligence

Fixed vs. Growth Mindsets



When students are asked to think intuitively, they stop thinking narrowly about a single method and use their sense making and reasoning skills to consider the appropriateness of different methods (Boaler 2016).

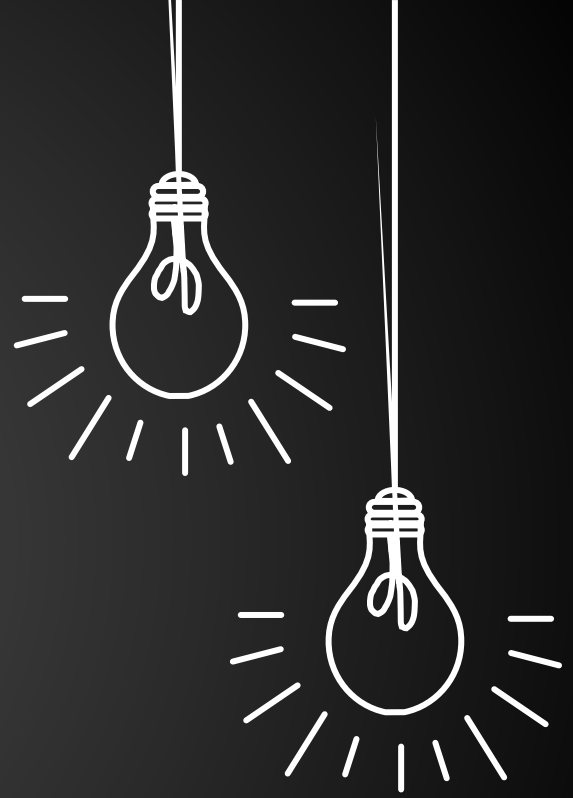
Fixed vs. Growth Mindsets

Examples of students with a fixed mindset:

- The most social student in the classroom, whose mathematics anxiety is disguised by their outgoing personality (Dweck, 2016).
- The strongest student in the classroom in the areas of reading and writing, who does not believe that mathematics is something she can do.
- The fastest student in the classroom when asked to recite mathematics facts, who is unable to infer and problem solve when asked.

Frustration Discomfort in Mathematics

Growth mindset is related to frustration tolerance in that it should encourage students to interpret frustration as less ego-threatening. By enduring frustration and sticking to challenging tasks, students can make breakthroughs in their understanding of difficult academic material (Meindl et al. 2019).



Frustration Discomfort Scale

Frustration discomfort and growth mindsets of preservice teachers in mathematics

Frequency of Responses, per FDS Factor

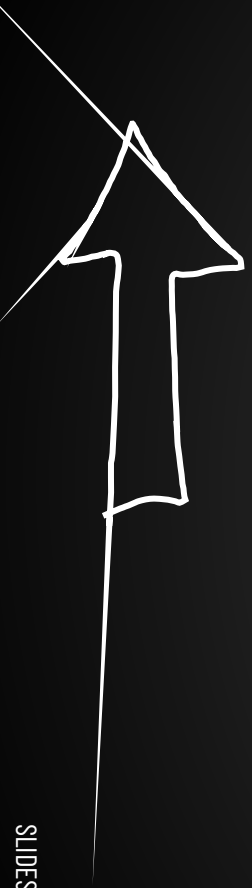
(n = 176 X 7 items, per Factor)

	Absent	Mild	Moderate	Strong	Very Strong
Factor I Discomfort Intolerance	**152 (12%)**	**464 (38%)**	375 (30%)	189 (15%)	52 (4%)
Factor II Entitlement	129 (10%)	353 (29%)	368 (30%)	291 (24%)	91 (7%)
Factor III Emotional Intolerance	151 (12%)	349 (28%)	388 (31%)	264 (21%)	80 (6%)
Factor IV Achievement Frustration	72 (6%)	210 (17%)	373 (30%)	**379 (31%)**	**198 (16%)**

Growth Mindset & Achievement Frustration

The data suggested that preservice teachers with a growth mindset were frustrated when they were prevented from achieving their full potential.

In theory, someone with a growth mindset strives to persevere through obstacles to achieve their full potential, and therefore may be frustrated when they are prevented from doing so.



Fostering a mathematical growth mindset

Decreasing mathematical frustrations

CCSS Mathematical Practice: Make sense of problems and persevere in solving them.

NCTM Teaching Practice: Support productive struggle in learning mathematics.

The National Council of Teachers of Mathematics (2017) defines productive struggle as "perseverance in completing difficult, yet attainable, goals that often have led to feelings of empowerment, efficacy, and hope."

According to the MIND Research Institute (2021), "productive struggle is a state of engagement that enables students to work through increasingly challenging problems and new problems they have never seen before, thus requiring students to persevere"

What does productive struggle look, sound, and feel like?

1. Teacher poses “just right” task and scaffolds; referencing visuals, manipulatives, or previous experiences.
2. Students try various strategies to solve; writing, drawing, or creating with visuals and manipulatives, and participate in classroom discourse.
3. Teacher praises students’ effort and **perseverance** and facilitates classroom discourse by posing purposeful questions, but resists taking over students’ thinking when they are stuck and **frustrated**.
4. Students **persevere** to solve when strategies aren’t applicable and solutions aren’t accurate. Students conclude by participating in mathematics classroom discourse about various paths towards the solution.

How do we get students to EMBRACE & LOVE productive struggle?

One rich, rigorous problem can allow students to pause and **wade in the waters of the unknown** as they grapple with the meaning of the problem and possible strategies to solve.

Math problem should include:

- Authentic context
- Multiple steps to solve with various operations
- Multiple strategies to solve (Concrete- PIctorial- Abstract)
- Opportunities for individual think time then processing through discourse

Teaching Resources for Implementing Productive Struggle in the Classroom:

Growth Mindset

- Jo Boaler's youcubed
- Jo Boaler's Mathematical Mindset, 2nd Edition

- 3 Ways to Promote Social Emotional Learning Through Math

SERP Institute

- Math By Example
- The 5X8 Card

Math Tasks

- Open Middle Problems
- Numberless Word Problems
- Real World Problems

More!

- Three Reads
- Discourse Actions
- Figuring Out Fluency

Thank you!

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