Minds over Matter:
Growth Mindset in the Postsecondary Classroom

National Council of Teachers of Mathematics
Annual Conference, Washington D.C.
April 27, 2018
The Minds
University of Nebraska at Kearney

Kaye Sorensen
Senior Lecturer of Mathematics & Statistics

Interests:
- Bridge Program
- Entry level courses
- Underprepared students

Keri Pearson
Assistant Director of the Learning Commons

Interests:
- Tutoring strategies
- Math support services

Amy Nebesniak
Associate Professor of Mathematics Education

Interests:
- Underprepared students
- Training future teachers
The majority of UNK are successful in math, but we want to find ways to encourage even greater success.

**Problem:**

Low math self-efficacy and student perseverance in entry-level math courses.

**Symptoms:**

- Negative attitudes towards math
- Apathy
- High DFW rates in GS math courses
- Delayed graduation
Many “Solutions” Ran Us into Brick Walls

<table>
<thead>
<tr>
<th>No control outside classroom and service borders</th>
<th>No institutional money to implement ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department not focused on entry level math courses</td>
<td></td>
</tr>
</tbody>
</table>
We didn’t know which way to turn, until...
Mindsets Overview

“My research has shown that the view you adopt for yourself profoundly affects the way you lead your life.”

--Dr. Carol Dweck, Stanford University (2006)
According to researcher Carol Dweck and others, growth mindsets and fixed mindsets frame the running account taking place in people’s heads. They guide the whole interpretation process.
Mindsets Overview

Neuroplasticity
Growth Mindset Goes to College

We sought ways around, rather than through, the brick walls:

1. Pacing efforts to engage real culture change by collaborating across organizational “silos”
2. Researching what other colleges have done with mindsets
3. Selecting intervention strategies that can be universally implemented

No control outside classroom and service borders
No institutional money to implement ideas

Department not focused on entry level math courses
Culture Change

Our approach to culture change evolved

- Revolutionary Change
- Incremental Change
Differences in Higher Education

Unique circumstances in postsecondary education require we seek ways to build a growth mindset culture that may be different from K-12 schools.

<table>
<thead>
<tr>
<th></th>
<th>High School</th>
<th>College</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class time</strong></td>
<td>Every day, 4-5 hours per week per class</td>
<td>Every other day, 2½ hours per week per class</td>
</tr>
<tr>
<td><strong>Class time use</strong></td>
<td>Thorough reviews/repetition in class</td>
<td>Limited repetition and test prep</td>
</tr>
<tr>
<td><strong>Emotional state</strong></td>
<td>Changing emotions about academics</td>
<td>Emotions “hard wired” to subjects</td>
</tr>
</tbody>
</table>
Growth Mindset Research

The bulk of higher education intervention research does not mention growth mindset. Instead, research focuses on changing student behaviors rather than mindsets.

**COMMON INTERVENTIONS:**
- STEM initiatives recruiting majors
- Summer bridge programs
- Study skills classes
- Academic support services
- Blended skills/content curriculum
Mindset Interventions

Social Psychological Interventions

Content-specific Interventions
Mindset Interventions

Social-Psychological

Suggestions for Implementation

The Intervention should be:
1. psychologically contextual
2. subtle (sneaky)
3. recursive
4. timed at “key educational junctions”

Key Implementation Strategies

❖ Teach about brain plasticity
❖ Explain the power of mistakes
❖ Believe in and encourage ALL students
❖ Value struggle and failure
❖ Praise effort, not “intelligence”

To make a difference, you must intervene in the right way.
Mindset Interventions

Math Content Interventions

Suggestions for Implementation

The 5 C’s of Mathematics
1. Curiosity
2. Connections
3. Challenge
4. Creativity
5. Collaboration

Key Implementation Strategies
- Open-ended problems
- Find the mistake problems
- Non-examples
- Math talk (discourse)
- Value depth over speed
- Visual mathematics
- Mathematical modeling
- Emphasize reasoning and sense-making

Teach math as an open, creative, inter-connecting subject.
Our Mindset Interventions

Social Psychological Interventions

1. Neuroplasticity
2. Productive Struggle

Content-specific Interventions

3. Using Mistakes
4. Math Talk
Intervention 1: Neuroplasticity

1. What is something in the video that caught your attention?

1. How does brain plasticity apply to your learning in this class?

1. **Math Ed**: How does brain plasticity apply to your future students’ learning?

3. **College Algebra**: How does brain plasticity apply to working with your class study partner?

Social-Psychological Intervention
Intervention 2: Productive Struggle

1. What is something in the video that caught your attention; surprised you; gave validation?

1. How does learning from mistakes apply to your learning and growing in this class?

1. Math Ed: How can you apply this to your future teaching career?
Intervention 3: Using Mistakes

College Algebra:
The student mistakenly writes this function’s domain set here. What could be done to improve this response and why?

[1] function? Yes
[2] D: \(-4 \leq x \leq 5\)
R: \(\{0\}\)

c) of ordered pairs: \{(5,0), (4,0), (−4,0)\}

Math Education:
Maurice rewrites 6(3 \cdot 7) as \((6 \cdot 3) \times (6 \cdot 7)\) and says he is using the distributive property. What is his misconception? How would you help him understand his mistake?

Content-Specific Intervention
Intervention 4: Math Talk

College Algebra:
Discuss two approaches to finding this distance.
(1) using your graph
(2) using your algebra

How could we use some math language to describe each approach?

Math Education:
*Think-Pair-Share
*Simon Says
*Partner Coach
*Quiz-Quiz-Trade

Content-Specific Intervention
Assessment 1: SMQ-II Survey

Never (0), Rarely (1), Sometimes (2), Often (3), Always (4)

Examples:
1. I enjoy learning math.
2. I am sure I can understand math.
3. I put enough effort into learning math.
4. Getting a good math grade is important to me.
5. Understanding math will benefit me in my career.

5 Components:
- Intrinsic motivation
- Self-efficacy
- Self-determination
- Grade motivation
- Career motivation

The SMQ-II assesses components of students' motivation to learn science/math in college and high school courses.
Assessment 1: SMQ-II Survey

<table>
<thead>
<tr>
<th>Category</th>
<th>Female Change in Percent Growth Mindset</th>
<th>Male Change in Percent Growth Mindset</th>
<th>TOTAL Change in Percent Growth Mindset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsic Motivation</td>
<td>1.81%</td>
<td>-7.14%</td>
<td>2.42%</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>8.25%</td>
<td>-12.38%</td>
<td>-1.21%</td>
</tr>
<tr>
<td>Self-Determination</td>
<td>-3.57%</td>
<td>15.90%</td>
<td>4.85%</td>
</tr>
<tr>
<td>Grade Motivation</td>
<td>-6.73%</td>
<td>-6.96%</td>
<td>-7.27%</td>
</tr>
<tr>
<td>Career Motivation</td>
<td>11.52%</td>
<td>2.66%</td>
<td>6.06%</td>
</tr>
</tbody>
</table>

n = 33; 18 females, 15 males
### Assessment 1: SMQ-II Survey


<table>
<thead>
<tr>
<th>Category</th>
<th>Percent Growth Mindset Pre-Survey</th>
<th>Percent Growth Mindset Pre-Survey</th>
<th>Change in Percent Growth Mindset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrinsic Motivation</td>
<td>39.49%</td>
<td>74.87%</td>
<td>35.38%</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>61.54%</td>
<td>80.51%</td>
<td>18.97%</td>
</tr>
<tr>
<td>Self-Determination</td>
<td>70.26%</td>
<td>83.59%</td>
<td>13.33%</td>
</tr>
<tr>
<td>Grade Motivation</td>
<td>85.64%</td>
<td>93.33%</td>
<td>7.69%</td>
</tr>
<tr>
<td>Career Motivation</td>
<td>80.51%</td>
<td>92.82%</td>
<td>12.31%</td>
</tr>
</tbody>
</table>

n = 39; 36 females, 3 males
Intervention 1: Neuroplasticity

NEW TUTORS
1. Why do you like the subjects you tutor?
2. When we say someone is “good” at something, what does that mean?
3. When we say someone isn’t good at something, what does that imply?

LEVEL II TUTORS
1. How does neuroplasticity relate to asking probing questions?
2. How does brain plasticity impact studying?
Intervention 2: Productive Struggle

NEW TUTORS
1. What praise do you GET from teachers?
2. What praise do you GIVE to students?
3. How can praise build a growth mindset?

LEVEL II TUTORS
1. How can you help a student see they are struggling with a study behavior?
2. When can learning be messy? When can it be organized?

Social-Psychological Intervention
Intervention 3: Using Mistakes

ALL TUTORS
1. To summarize the end of a session, ask the student to **find a mistake** in the problem.
   a. Tutors quickly identified that just finding the mistake was **not enough**

LEVEL II TUTORS
1. When you look at these **notes**, what mistakes do you see?
Assessment 2: Tutor Observations

Observation Guidelines

- Praise effort, not outcome (social/psy)
- Ask student to find, correct, and describe at least one mistake (content)
- Use open tasks to help a student think through problems and ideas (content--not yet part of training)
Assessment #2: Tutor Observations

● Engaging effort instead of outcomes
  ○ adjust what is said to reflect peer relationships
    ■ “I appreciate you worked on this first.”
    ■ “Looking back, you’ve done a lot more work on your own this time.”

● Finding a mistake
  ○ Have “ready” problems to make it efficient
  ○ Use an activity in study groups
  ○ Connect with the 3-step tutoring process (TryCycle)
Incremental Impact

- Career presentation (4th graders)
- Thompson Scholars article
- STEM day on campus (middle school students)
- College of Education presentation
- PD at local elementary school
- College study skills presentation (high school seniors)
- Undergraduate Research Day student poster
- Academic & Career Services EAA revision
- Math 90 presentation
Thank you for our time together.

For more about mindsets, mathematical mindsets, and change in higher education:


