Breaking Math: The Importance of Making Mistakes

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Robinson Center

- Early Admittance Programs to University of Washington
  - Transition School/ Early Entrance (EEP)
  - UW Academy
- Saturday Program
  - High Interest - No Qualifications
- Summer Programs
  - Qualifications for Specific Subject Areas
Saturday Programs

- Enrichment Program for K-8
- Focus on inspiration, fun, challenge
- Math, Science, Creative Writing, Philosophy
- Math class for parents
- No qualifications except grade level
- Financial Aid available
Powerful Learning

- People learn what is personally meaningful to them.
- People learn when they accept challenging but achievable goals.
- Much learning occurs through social interaction.
- A positive emotional climate strengthens learning.
- Learning is influenced by the total environment.

Research on Impact of Saturday Math Enrichment

- Explore the nuances of teaching and learning in Saturday math enrichment classes for students, grades 4-8.
- Impact of participation on student learning, math interest and identity
- Documented instructional strategies that enhanced students’ enthusiasm and motivation for learning math
Participant Demographics

- TOTAL N = 40
- GENDER
  - Male = 57.5%, Female = 42.5%
- RACE/ETHNIITY
  - Caucasian/White = 37.5%
  - Asian American = 25%
  - N/A = 12.5%
  - Hispanic/Latino = 15%
  - Other = 10%
- HIGHLY CAPABLE PROGRAM = 50%
- TUITION WAIVERS = 22.5%
Math Enrichment Classes

**Six classes – Geometry and Algebraic Concepts**

- **Grades 4-5**
  - Polygons A, Polygons B, All the Difference
- **Grades 6-8**
  - Septagon A, Septagon B, And So On (6-8)
- **Class size - 12-24 students.**
- **Instructors were mathematicians with deep content expertise**
Math Content

◆ Septagons and Polygons:
  ◆ Geometric ideas, tessellations, platonic solids, and more.
  ◆ Study of shapes, angle sum formulas, Pythagorean Theorem,
  ◆ Areas of certain polygons
  ◆ Similarity and congruence

◆ All The Differences and And So On:
  ◆ Geometry and arithmetic inspired patterns, encode patterns mathematically, create table of differences
  ◆ number patterns, predicting patterns, sequences
Quantitative Results

WHOLE GROUP, n= 28

◼ I am interested in math.
  ◼ First Day Mean: 3.68, Last Day Mean: 3.71
  ◼ No Significant Difference, $p>.05$
  ◼ Overall High Rating

◼ I see myself as a mathematician.
  ◼ First Day Mean: 2.72, Last Day Mean: 2.74
  ◼ No Significant Difference, $p>.05$
  ◼ Overall Medium to Low Rating
Quantitative Results

WHOLE GROUP, $n=28$

I am interested in the things I learn in my school math class.

- First Day Mean: 3.21, Last Day Mean: 2.95
- *Significant Difference, $p<.05$
Qualitative Results

All the students reported that Saturday math class was different from their school math class.
Saturday and School Math
Group Activity

Saturday Math

School Math
Qualitative Results

Was this math class different from your school math class? Please explain.

- Different Concept/Subject Matter/Strategies
- Faster Pace/More Challenge
- More Fun
- Different Class Teaching/Learning Strategy
- Learning/Other
- Missing Data
Qualitative Results

Was this math class different from your school math class? Please explain.

- We did more challenging stuff here than at school.
- More complex math
- The kids go at a much faster pace.
- My school math class is too easy, this class is just right.
What Makes Enrichment Math So Different?

TEACHERS…

- Model Being a Mathematician
- Pose Open Ended Questions for Conceptual Exploration
- Provide a Supportive/Collaborative Environment where Student Contributions are Valued
- Encourage Discovery Through Play
Being a Mathematician

Through explicit instruction and implicit modeling from teachers, students learn that:

- Mathematicians “play with math.”
- Mathematicians explore “what we know, and what we are wrong about.”
- Mathematicians asks lots of questions, make mistakes, try different approaches, keep an open mind.
- Mathematicians think math is “cool”, “weird”, “beautiful”
- Mathematicians have fun!
Being a Mathematician

In enrichment math, making mistakes or being wrong is part of the natural process of discovery for a mathematician.

◆ THIS VIDEO CLIP HAS BEEN REMOVED
Open-Ended Questions for Conceptual Exploration

- What do we need to know how to predict how a sequence will behave?
- How do you describe the shape?
- Does anyone have any ideas on what my rule could be here?
- What else? What other attributes of shape could...might be connected?
- What was the most useful guess to you when somebody said it? Which was the one that helped you the most to see what it was?
Supportive and Collaborative Environment

Teachers create a supportive and collaborative environment by:

- Implicit and explicit modeling that it’s okay to take risks
- Repeatedly inviting students to share their ideas multiple times and in multiple ways
- Affirming and valuing student contributions (right or wrong!)
- Seeking out diverse opinions
- Giving Student “Authorship”
Student Authorship

In enrichment math, teachers value student contributions and often engage with their ideas.

◆ THIS VIDEO CLIP HAS BEEN REMOVED
Challenge: Break the 8 Squares

In enrichment math, teachers challenge students and encourage discovery through play.

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Challenge: Counterexamples

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Making Connections

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Concluding Thoughts

“We actually learn what it really is by guessing the things that are unsafe...it’s not until you try to break out of the pattern and do something that won’t work, that you actually start to see what it is...”

-Dan Finkel
DISCUSSION
GROUP ACTIVITY

- How can we incorporate more of Saturday enrichment math strategies into school math?
- Do you foresee any challenges?