

The Role of Mindset in Developing Students' Mathematical Talent

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Presenter: Jerry Burkhart

5280 Math Education

jerry@themathroom.org

5280math.com (under development—coming soon)

Mindset-Oriented Strategies* for Developing Mathematical Talent

1. Choosing activities that encourage a growth mindset
2. Introducing students to challenging activities
3. Supporting students during the problem solving process
4. Assessing and commenting on student work

*See Mindset, Carol Dweck, 2008

Math activities for Developing a Growth Mindset

- Create "disequilibrium" or "productive frustration."
- Take a significant amount of time to solve.
- Have multiple paths to solutions (or multiple solutions).
- Suggest possibilities for further exploration.
- Are open-ended with multiple points of entry and exit.
- Provide opportunities for mathematical communication.
- Are not necessarily "story problems."

To encourage a growth mindset when introducing activities...

- **Let students know what to expect in advance.**
 - It will take a long time.
 - You will probably get stuck sometimes.
 - You will probably not get everything right.
 - You may not finish.
 - It is possible to show progress in your learning even if you don't get it "right."
- **Make it clear what you value.**
 - effort
 - progress
 - creative ideas
 - thinking of other interesting questions to ask
 - having good reasons for your answers
 - explaining your thinking clearly
 - making connections between ideas
 - precise use of math vocabulary
- **Tell students how you will support them through.**
 - This may include:
 - Telling them when they may approach you with questions.
 - Allowing, even encouraging, them to collaborate with other students.
 - Guiding them to understand the meaning of questions.
 - Helping them learn to put their thoughts into words.
 - Emotional support - helping them manage frustration.
 - Occasional guiding questions or hints.
 - It probably will not include:
 - Suggesting "steps" to do the problems.
 - Telling them answers.
- **Ensure that students have the needed background.**

To Support Students During the Problem Solving Process...

- Give them strategies for managing frustration.
- Talk about mindset, feelings, and experiences with students.
- Resist the urge to “rescue” students by lowering the challenge.
- Create discussion:
 - That is built on *students’* ideas.
 - That allows students to critique and learn from others’ ideas, including errors.

To Encourage a Growth Mindset in the Assessment Process...

- Praise *effort* and *process*, not ability and answers.
- Write specific comments related to the mathematical content – showing an interest in students' ideas.
- Write comments focused on growth/progress in learning.
- Suggest further questions to think about.
- Ask students to reflect on their experience (mindset, level of engagement, feelings, etc.) and how they responded to obstacles.

Mathematical Mystery Code

Partial Solution

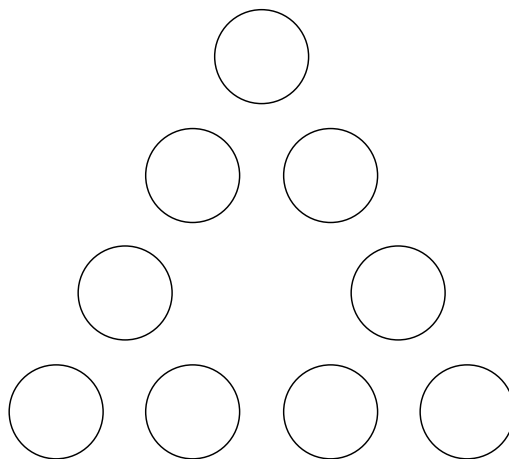
| Number | Code |
|--------|-----------|
| 0 | none |
| 1 | 0 |
| 2 | 1 |
| 3 | 10 |
| 4 | 2 |
| 5 | 100 |
| 6 | 11 |
| 7 | 1000 |
| 8 | 3 |
| 9 | 20 |
| 10 | 101 |
| 11 | 10000 |
| 12 | 12 |
| 13 | 100000 |
| 14 | 1001 |
| 15 | 110 |
| 16 | 4 |
| 17 | 1000000 |
| 18 | 21 |
| 19 | 10000000 |
| 20 | 102 |
| 21 | 1010 |
| 22 | 10001 |
| 23 | 100000000 |
| 24 | 13 |
| 25 | 200 |

Triangle Sums
Student Handout

Stage 1

1. Use each of the digits 1, 2, 3, 4, 5, 6, 7, 8, and 9 exactly once to fill in the circles.

Make the sum of each side equal to 17. Describe your thinking strategies.



2. Find a different solution to the problem.
3. What important feature do your solutions have in common?
4. How can you see that these are the only two solutions?

From *Advanced Common Core Math Explorations: Numbers and Operations*, by Jerry Burkhart. Prufrock Press, 2014

Stage 2

5. Add the counting numbers 1 through 9. Then calculate 17×3 . How does this relate to the original Triangle Sums problem? Why aren't the two answers the same?
6. Why must your two solutions have the common feature you described in question 3? How does this show you another way to see that there are only two solutions? Explain.
7. Fill in the circles with the numbers 1, 2, 3, 4, 5, 6, 7, 8 and 9 as before. Try to make the three sides have the same sum, but this time larger than 17!
8. Why can't "Triangle Sums" be solved for a sum smaller than 17? Explain.

Stage 3

9. Suppose you have a triangle with five circles on each side instead of four. Using the numbers 1 – 12, what is the smallest sum that will allow a solution to the problem? Explain your thinking.
10. Solve the new problem using this sum.
11. Imagine triangles with more and more circles on each side. Describe a method for finding the smallest sum that will allow a solution, no matter how many circles are on each side of the triangle.
12. Complete a table showing the smallest sum for triangles with 3, 4, 5, 6 and 7 circles per side.
13. Discover and describe a pattern in the smallest sums. Use your pattern to predict the next three sums.
14. Think of at least three more questions to extend the "Triangle Sums" exploration.

From *Advanced Common Core Math Explorations: Numbers and Operations*, by Jerry Burkhart. Prufrock Press, 2014

Resources

Adding It Up, by the National Research Council, 2001

Advanced Common Core Math Explorations series, by Jerry Burkhart. Prufrock Press, 2014 – 2015

Extending the Challenge in Mathematics, by Linda Sheffield. Corwin Press, 2003

Mindset: How You Can Fulfil Your Potential, by Carol Dweck. Robinson, 2008

Mindsets and Math/Science Achievement, by Carol Dweck, 2008. www.opportunityequation.org

Overcoming Math Anxiety, by Shiela Tobias. W.W. Norton & Company, Revised edition, 1995.

Principles to Actions: Ensuring Mathematical Success for All. NCTM, 2014

The Teaching Gap, Stigler and Hiebert. Free Press, 2009

Additional activities will be available upon request after the presentation.

Jerry Burkhart
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jerry@themathroom.org
5280math.com (under development – coming soon!)

Education and experience

- B.A. Physics; M.A., Mathematics, M.A.T., Math Education
- 20 years teaching gifted math students
- 7 years professional development/coaching

Publications

Advanced Common Core Math Explorations: Factors and Multiples, 2014
Advanced Common Core Math Explorations: Numbers and Operations, 2104
Advanced Common Core Math Explorations: Fractions, 2104
Advanced Common Core Math Explorations: Measurement and Polygons, 2015

coming in 2016:

Advanced Common Core Math Explorations: Ratios, Proportions, and Similarity
Advanced Common Core Math Explorations: Probability and Statistics

all books published by Prufrock Press, www.prufrock.com

Building numbers from primes. *Mathematics Teaching in the Middle School*, NCTM, October, 2009.

Integer target: using a game to model integer addition and subtraction.
Mathematics Teaching in the Middle School, NCTM, March, 2007.

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