Supporting Productive Struggle Using a Popular Puzzle

Using the Rubik’s Cube in the Gifted Classroom

Beau Scott
Elementary Math and Science Specialist

@NerdcoreTeacher  @EducateIN
<table>
<thead>
<tr>
<th>Objective One</th>
<th>Help support Productive Struggle within the Gifted Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective Two</td>
<td>Provide resources to spark interest in utilizing the Rubik’s Cube for both teachers and students.</td>
</tr>
</tbody>
</table>
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.
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.
Math Process Standards

1. Making 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
Math Process Standards

1. Making 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
## Support Productive Struggle

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Teacher Actions</th>
<th>Student Actions</th>
</tr>
</thead>
</table>
| ❑ Essential to learning mathematics with understanding | ❑ Support student struggle without showing and telling a procedure  
❑ Ask questions that scaffold and advance student thinking  
❑ Build questions and plan lessons based on important student misconceptions rather than focusing on correct answers  
❑ Recognize the importance of effort | ❑ Stick to tasks and recognize that struggle is part of making sense  
❑ Ask questions to better understand the task  
❑ Support each other with ideas rather than telling others the answer or how to solve a problem |

❑ Give students ample time to work with and make sense of new ideas

Adapted from: John Hattie’s (2017, p. 244) summation from Principles to Action (National Council of Teachers of Mathematics, 2014)
8 Habits that Block Productive Struggle in Math Class

1. Calling on students who know the right answer.
2. Praising students for their smarts.
3. Creating bulletin boards to display high achievement.
4. Focusing on teaching procedures and formulas.
5. Making student responses right or wrong.
6. Giving easier work to struggling students.
7. Following a strict schedule for covering new material.
8. Making students feel okay about not being a “math person”.

mindresearch.org
8 Habits that Promote Productive Struggle in Math Class

1. Call on students who may NOT have the correct answer.
2. Praise students for perseverance in problem solving, not for being smart.
3. Display work that shows creative problem solving, not the highest scores.
4. Provide non-routine problems that can’t be solved with a memorized formula.
5. Give students informative feedback.
6. Don’t give easier work to struggling students.
7. Allow students time to ask questions and tinker with ideas.
8. Encourage having a growth mindset.

mindresearch.org
Examples

THE LEARNING PIT

- Problem-Solving
  You may feel angry, distracted, frustration, challenge, confusion, or uncomfortable.

- Taking a Chance
  You may feel anxious, nervous, scared, excited, or comfortable.

- Stepping into the Learning Pit
  You should feel achievement and pride.

- Having a Go
  You may feel interested, hooked, and use prior knowledge.

- Stepping into the Learning Pit
  You may learn a sense of collaboration and concentration.
CHALLENGE!
QUESTION!

I JUST GOT MARRIED!
Cubing in the Classroom
Where is the line of symmetry? Is there more than one line of symmetry?

Change *two* squares so there is exactly one line of symmetry.
Rotational Symmetry

- Create a design on one face of your cube so that it has 90 degree rotational symmetry.

- Create a design on one face of your cube so that it has 180 degree rotational symmetry.
Look at one side of your cube
- How many tiles are on one face?
- How many of those tiles are blue?
- Write the fraction of blue tiles on that face in simplest form.
- What fraction of that face is not blue?
Look at one side of your cube
- How many tiles are on one face?
- How many of those tiles are blue?
- Write the fraction of blue tiles on that face in simplest form.
- What fraction of that face is not blue?
Solving the Cube

FACES
The flat (two-dimensional) square, on each surface of the cube. There are six (6) faces on the cube, each with a directional name.

Up Face
Down Face
Left Face
Right Face
Front Face
Back Face
Solving the Cube

Each turn is $90^0$. ‘i’ means invers. ‘Ri’ is a counter clockwise turn.
THANK YOU!

Please Take a Moment to Provide Feedback by Clicking the Link

IAG Feedback

Beau Scott
Elementary Mathematics Specialist
Office of School Improvement
Jscott3@doe.in.gov