Effective Differentiation in Mathematics

presented by

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ISBE Math Content Specialists

Today’s slide decks are available at http://www.mathteachersinaction.org/
Session Objectives

✓ Define Differentiation

✓ Explore DI strategies for math.
  • Math Talks
  • Open Questions
  • Multiple Access Points
  • Student Choice

✓ Considerations
A definition for today...

Differentiation refers to a wide variety of teaching techniques and lesson adaptations that educators use to instruct a diverse group of students, with diverse learning needs, in the same course, classroom, or learning environment.

Differentiation is modifying the content, process, or product of a learning experience based on individual students’ needs and/or interests.
Why is differentiation so important?

• Our classrooms are full of diverse learners
• Teaching everyone one way will alienate someone
• Meeting students needs and interests will help alleviate many discipline issues
• Meeting students needs and interests will help them achieve at a higher level
• Connections to Danielson
Roadblocks to Differentiation

What obstacles keep us from differentiating?
Strategies for Differentiating:

There are MANY different ways to differentiate math instruction to meet the needs of all the learners in your classroom. Today we are going to look at these 4 methods. Our focus is on “inclusive” differentiation strategies.

1. Math Talks
2. Open Questioning
3. Multiple Access Points
4. Student Choice
Math Talks

• The teacher poses a purposeful problem.
• Students signal when they are ready to share a solution.
• The teacher collects answers orally.
• Students explain or defend their answers.
• The teacher records student strategies and asks questions to facilitate mathematical discourse.
• Finally, the class comes to a consensus.

ilteachandtalk.org
38 + 37
Why it works...

- Students become more active listeners, eager to hear the different strategies shared.

- Emphasis is on the solution path or strategy not the answer.

- Deeper conceptual understanding due to the analysis of the mathematical reasoning behind the strategies.

- Students use the math skills they are most comfortable with to approach the problem.
Open Problems

Open refers to a problem which has more than one correct answer and more than one strategy to obtain an answer.
Grade 1 -

How could you organize 27 skittles to make them easier to count?
Grade 3 -

Using the digits 1 through 9, at most one time each, fill in the blanks to make the following problem true.

Sarah planted __ __ carrots in her garden. She planted them in __ rows. Each row had __ carrots.

Grade 5 -

Using the digits 1 through 9, exactly once each, so that each expression is simplified to a different odd number.

5.OA.1 http://www.openmiddle.com/order-of-operations-5/
Why it works...

- Students are exposed to many different ways of thinking.

- All students can approach the problem using the skills they are personally comfortable with.

- Many different ways of thinking are acknowledged and validated.

- Students reach a deeper level of conceptual understanding.
Problems with Multiple Access Points

• Engaging students with problems that can be solved in multiple ways

• Approached with different skill sets
A Fourth Grade Example -

Consider a collection of pennies with the following constraints:

When the pennies are put in groups of 2 there is one penny left over. When they are put in groups of three, five and six there is also one penny left over. But when they are put in groups of seven there are no pennies left over.

How many pennies could there be?

4.OA and 4.NBT

From Jo Boaler’s (youcubed.org) Week of Inspirational Maths 4
“My ideal oreo cookie would be a triple double. What would be the nutritional information of a triple double?”
Why it works...

• Again, students are approaching the problem with the math that they are most comfortable with.

• The problem is grade level appropriate.

• Students see connections between the various strategies.
Student Choice

• Engage students with Variety and Choice.
• Provide your students with a variety of contexts in which they can apply the math.
• Provide different ways for them to explore the math - hands on manipulatives, technology, drawings, etc.
How can we make this easy to implement?

- Come up with a template or pattern that you follow.

- Find resources that you can easily use as a choice
  
  - ISBE Choice Board Examples (Grades 2-7)
  - Grade 8 and Algebra 1 (*Thank you, Trish DeFino and Sarah Wentworth for creating and sharing these with us!*)
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<tr>
<th>Task 1</th>
<th>Task 2</th>
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<tr>
<td>2.MD.8</td>
<td>2.NBT.7</td>
<td>2.OA.1</td>
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<tr>
<td>Making Change</td>
<td>Math Riddle</td>
<td>Jelly Belly</td>
</tr>
<tr>
<td>Fun Fact: There are 293 ways to make change for a dollar.</td>
<td>Solve Mentally See Handout</td>
<td>Visit the Jelly Belly website and write down three numerical facts. For example, there are 50 original flavors. Use these facts to create 3 start unknown word problem.</td>
</tr>
<tr>
<td>List three ways to make change for a dollar</td>
<td>Source: Brainle</td>
<td><a href="https://www.jellybelly.com/">https://www.jellybelly.com/</a></td>
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<th>Task 4</th>
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<tr>
<td>2.NBT.7</td>
<td>2.NBT.6</td>
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<tr>
<td>Magic Squares</td>
<td>Phone Number Math</td>
<td>Solve using both addition and subtraction</td>
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<tr>
<td>Find Magic Square activity and choose 2 squares. <a href="https://www.k-5mathteachingresources.com/2nd-grade-number-activities.html">https://www.k-5mathteachingresources.com/2nd-grade-number-activities.html</a></td>
<td>Find a phone number where the sum of all the digits is greater than 30</td>
<td>Josh has 112 pencils. He gives some pencils to his friends. Now, he has 27 left. How many pencils did he give away? Solve using a model.</td>
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<tr>
<th>Task 7</th>
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<tr>
<td>2.MD.1</td>
<td>2.MD.8 and 2.NBT.5</td>
<td>2.NBT.6</td>
</tr>
<tr>
<td>Do the Write Thing!</td>
<td>A Jar of Coins</td>
<td>Magic Square</td>
</tr>
<tr>
<td>Write these words and measure their length to the nearest centimeter. Choose 3 words to write and measure. Then add the total length of all three words.</td>
<td><a href="https://www.illustrativemathematics.org/content-standards/2/MD/C/8/tasks/1071">https://www.illustrativemathematics.org/content-standards/2/MD/C/8/tasks/1071</a></td>
<td></td>
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<tr>
<td>Experiment Investigation Multiplication</td>
<td>See the attached activity. Feel free to use a real jar of coins to help you.</td>
<td>If the Magic number is 15, fill in the missing squares.</td>
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3 1 6
9 7
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<td><strong>3.OA.1</strong>&lt;br&gt;<strong>Subitizing Flash Cards</strong>&lt;br&gt;Practice multiplication with the subitizing cards and a partner.&lt;br&gt;<a href="https://gftchx.files.wordpress.com/2014/03/multiplication-subitizing-cards.pdf">https://gftchx.files.wordpress.com/2014/03/multiplication-subitizing-cards.pdf</a>&lt;br&gt;Source: Graham Fletcher</td>
<td><strong>3.OA.5</strong>&lt;br&gt;<strong>Color in Multiplication Facts</strong>&lt;br&gt;Handout below&lt;br&gt;Source: EngageNY&lt;br&gt;<a href="https://www.engageny.org/resource/grade-3-mathematics-module-3-topic-lesson-3">https://www.engageny.org/resource/grade-3-mathematics-module-3-topic-lesson-3</a></td>
<td><strong>3.OA.1 &amp; 2</strong>&lt;br&gt;<strong>Tic Tac Toe Products Game</strong>&lt;br&gt;Play with a partner.&lt;br&gt;<a href="https://www.youcubed.org/tasks/tic-tac-toe-products/">https://www.youcubed.org/tasks/tic-tac-toe-products/</a>&lt;br&gt;Tic-Tac-Toe Products Board&lt;br&gt;Source: YouCubed at Stanford University</td>
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<td><strong>3.OA.3</strong>&lt;br&gt;<strong>Largest Product</strong>&lt;br&gt;Using the numbers 1-4, no more that one time each, make the largest product.&lt;br&gt;□□□□&lt;br&gt;×&lt;br&gt;□□&lt;br&gt;Source: openmiddle.com&lt;br&gt;<a href="http://www.openmiddle.com/multiplying-a-two-digit-number-by-a-single-digit-number/">http://www.openmiddle.com/multiplying-a-two-digit-number-by-a-single-digit-number/</a></td>
<td><strong>3.OA.3</strong>&lt;br&gt;<strong>Array Picture Cards</strong>&lt;br&gt;<a href="https://www.k-5mathteachingresources.com/3rd-grade-number-activities.html">https://www.k-5mathteachingresources.com/3rd-grade-number-activities.html</a>&lt;br&gt;Scroll down to section 3.OA.3 and select the link to the activity “Word Problems: Arrays set 1.” Complete three word problems by writing an equation with a symbol for the unknown number, drawing an array to model the problem, and writing the answer in a complete sentence.&lt;br&gt;Source: K-5 Math Teaching Resources</td>
<td><strong>3.OA.3</strong>&lt;br&gt;<strong>Arranging Chairs</strong>&lt;br&gt;Handout below&lt;br&gt;Source: Howard County Public School System&lt;br&gt;<a href="https://hcpss.instructure.com/courses/97/pages/3-dot-dot-dot-3-about-the-math-learning-targets-and-">https://hcpss.instructure.com/courses/97/pages/3-dot-dot-dot-3-about-the-math-learning-targets-and-</a> rigor</td>
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<td><strong>3.NF.3</strong>&lt;br&gt;<strong>Make a Picture</strong>&lt;br&gt; If a &lt;br&gt;Is equal to&lt;br&gt; 1/3&lt;br&gt;design a picture that would be equal to 4.</td>
<td><strong>3.OA.5</strong>&lt;br&gt;<strong>One Hundred Hungry Ants</strong>&lt;br&gt;Watch the video “Ants Go Marching”.&lt;br&gt;Suppose the number of Ants was 12, 24, and 36. How many different ways could the ants arrange themselves in equal arrays?&lt;br&gt;<a href="https://www.youtube.com/watch?v=PoXanko9pBo">https://www.youtube.com/watch?v=PoXanko9pBo</a></td>
<td><strong>3.OA.5</strong>&lt;br&gt;<strong>The Ants Go Marching</strong>&lt;br&gt;How many ants are on the page?&lt;br&gt;Use Arrays, repeated addition or multiplication arrays to help you solve. Be prepared to explain what steps you took to find your total without counting each ant. Handout below</td>
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Why it works...

- Students feel ownership of their learning and are therefore more engaged.

- Students are given opportunities to demonstrate their talents while exploring math concepts. Very empowering!
A few things to consider...

- Facilitate productive struggle.
  - I do... We do... You do... trains students to wait for the teacher

- Differentiate within the grade level.

- Empower students to reach their full potential.

- Provide opportunities for students to identify with context/content.
<table>
<thead>
<tr>
<th>Common Misstep</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>Blindingly adhering to a pacing guide/calendar</td>
<td>Use <em>formative data</em> to gauge student understanding and inform pacing</td>
</tr>
<tr>
<td>Halting instruction for a broad review</td>
<td>Provide <em>just-in-time</em> support within each unit or during intervention</td>
</tr>
<tr>
<td>Trying to address every gap a student has</td>
<td>Prioritize most essential prerequisite skills and understanding for upcoming content</td>
</tr>
<tr>
<td>Trying to build from the ground up or going back too far in the learning progression</td>
<td><em>Trace the learning progression, diagnose, and go back just enough</em> to provide access to grade-level material</td>
</tr>
<tr>
<td>Re-teaching students using previously failed methods and strategies</td>
<td>Provide a <em>new experience</em> for students to re-engage, where appropriate</td>
</tr>
<tr>
<td>Disconnecting intervention from content students are learning in math class</td>
<td>Connect <em>learning experiences</em> in intervention and universal instruction</td>
</tr>
<tr>
<td>Choosing content for intervention based solely on students’ weakest areas</td>
<td>Focus on <em>Major Work</em> clusters from current or previous grades as it relates to upcoming content</td>
</tr>
<tr>
<td>Teaching all standards in intervention in a step-by-step, procedural way</td>
<td>Consider the aspect of <em>Rigor</em> called for in the standards when designing and choosing tasks, activities, or learning experiences</td>
</tr>
<tr>
<td>Over-reliance on computer programs in intervention</td>
<td>Facilitate <em>rich learning experiences</em> for students to complete unfinished learning from previous or current grade</td>
</tr>
</tbody>
</table>

Annie Perkins

The Mathematicians Project: Mathematicians Are Not Just White Dudes

https://arbitrarilyclose.com/2016/08/21/the-mathematicians-project-mathematicians-are-not-just-white-dudes/
Need support with any of the materials included here? Reach out to one of our Math Content Specialists!

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