**Middle School Mathematics - Differentiation Strategies that Work**

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**What is Differentiation?**

Curriculum differentiation is a process used to maximize student learning by improving the match between a student's individual needs and the curriculum.

A general term used to describe the range of strategies, which are used to ensure children’s needs are met.

Curriculum differentiation is a broad term referring to the need to tailor teaching environments and practices to create appropriately different learning experiences for different students.

Adapting the curriculum to meet the unique needs of learners by making modifications in complexity, depth, and pacing.

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**Differentiation…**

Allows each student to work in his or her zone of proximal development (state of moderate challenge)

- Actual development level as determined under guidance or in collaboration with more capable peers
- Actual development as determined by independent problem solving

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**ZPD**

- Moderate Challenge
  - Know something
  - Have to think
  - Must persist
  - Effort leads to success

- Too Hard
  - Don't know where to start
  - Missing skills
  - Can't solve
  - Makes no sense

- Too Easy
  - Already knows
  - Gets it quickly
  - No effort needed

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**Why Differentiate?**

Pressure to standardize learning

- Students differ in abilities, interests, and learning styles
- Learning more enjoyable when choices are available
- Enjoyment and engagement contribute to higher achievement
- And, of course, the state says you must!
Teachers can differentiate by

Content  Process  Product
Curriculum Depth  Instructional Techniques  End Product

According to students’ Readiness  Interests  Learning Profile

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Create: Generating new ideas, products, or ways of viewing things
Evaluate: Justifying a decision or course of action
Analyze: Breaking information into parts to explore understandings & relationships
Apply: Using information in another familiar situation
Understand: Explaining ideas or concepts
Remember: Recalling information

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Bloom’s Taxonomy

- Evaluation
- Synthesis
- Analysis
- Application
- Comprehension
- Knowledge

Revision

- Creating
- Evaluating
- Analysing
- Applying
- Understanding
- Remembering

(Based on Pohl, 2000, Learning to Think, Thinking to Learn)

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Differentiation Strategies

- Curriculum Compacting
- Independent Projects
- Tiered Assignments
- Flexible Grouping
- Learning or Interest Centers
- Varying Questions
- Mentorships
- Learning Contracts

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To differentiate you must...

- Know your learning goals
- Know the ability range of your students

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The Value of Assessment or ...

You can’t figure out what to teach ‘em if you don’t know ‘em!

- Interest Inventories
- Learning Profile Inventories
- Preassessment Options - Ensure the Mastery of Basic Skills!
Ensure the Mastery of Basic Skills:

<table>
<thead>
<tr>
<th>Mastery</th>
<th>Not Mastery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition of situation</td>
<td>Can automatically recite</td>
</tr>
<tr>
<td>requiring repeated addition,</td>
<td>multiplication facts</td>
</tr>
<tr>
<td>uses multiplication to shorten</td>
<td></td>
</tr>
<tr>
<td>solution process</td>
<td></td>
</tr>
<tr>
<td>Uses variety of basketball</td>
<td>Primarily uses the bounce pass in</td>
</tr>
<tr>
<td>passes depending on best</td>
<td>basketball regardless of its</td>
</tr>
<tr>
<td>strategy for the moment</td>
<td>potential effectiveness</td>
</tr>
<tr>
<td>Can explain how the role of a</td>
<td>Can recite the definition of</td>
</tr>
<tr>
<td>number changes based on its</td>
<td>a mathematical property.</td>
</tr>
<tr>
<td>placement in the equation</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Wormeli, 2006

Preassessment Options

- Textbook Pretest
- Student/Teacher Conference - as short as a 5 minute talk
- K-N-W Chart - What do I Know, Need to know & Want to know
- Journal - Write what you know about...
- List - If I say ...
- Product - Draw a bar graph...
- Use the graphing calculator to plot...
- Concept Map...
- Five Hardest
- Exit Cards

Sample Prompts

- What one thing will you remember most about today’s lesson.
- List 3 things you learned today.
- List 2 examples of....
- What questions do you have about...
- Explain the difference between...
- What area gave you the most difficulty today?
- Something I still don’t understand it...

Questions to ask as you plan...

- Will what I have planned...
  - Meet all of the student’s needs?
  - Be necessary for all students?
  - Meet the needs of students who learn quickly?
- How will I know that students have mastered the material?

Challenge through Choice

- Questioning
- Compacting/Five Hardest
- Anchor Activities
- R.A.F.T.
- Think, Pair, Share
- Think Tac Toe
- Tiered Activity
**Questioning in the Classroom**

<table>
<thead>
<tr>
<th>Haynes</th>
<th>1935</th>
<th>70% recall</th>
<th>17% thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gall</td>
<td>1970</td>
<td>60% recall</td>
<td>20% thinking</td>
</tr>
<tr>
<td>Kroll</td>
<td>1980</td>
<td>29% recall</td>
<td>23% thinking</td>
</tr>
<tr>
<td>Kerry</td>
<td>1989</td>
<td>54% routine</td>
<td>1% thinking</td>
</tr>
<tr>
<td>Wragg</td>
<td>1993</td>
<td>57% routine</td>
<td>8% thinking</td>
</tr>
<tr>
<td>Lincoln</td>
<td>1996</td>
<td>60% recall</td>
<td>20% routine</td>
</tr>
</tbody>
</table>

**Ask Open Ended Questions**

- Take away the question.
  - Three ducks and 2 ducklings weigh 32 kg. Four ducks and 3 ducklings weigh 44 kg.
- Here is the answer, what is the question.
  - The answer is 27
  - The answer is \( \geq 32 \)
- Give an example of an event that has a probability of 0. Provide proof.

**Wait Time**

Provide time for reflection

Students may be resistant to “having to think”

- Wait Time
  - Averages one second or less.
  - Students whom teachers perceive as slow or poor learners are given less wait-time than those teachers view as more capable.
  - Increase in wait-time over three seconds has a positive effect on the number of higher cognitive questions asked by teachers.
  - Got the answer? Give me a hint…

**Curriculum Compacting**

Used to modify and/or streamline the regular curriculum to eliminate repetition of previously mastered material, upgrade the challenge level of the regular curriculum, and provide time for enrichment and/or acceleration activities.

**Compacting Steps**

1. What do you want them to know?
2. What do they know?
3. Offer enrichment or acceleration activities to those who already know it.
4. Keep records for accountability.

http://www.gifted.uconn.edu/siegle/CurriculumCompacting/INDEX.HTM

**Five Hardest (Short Cuts)**

- Teacher or student selects the 5 (or other number) most difficult problems on the page
- Do with 80% accuracy and...
  - NEATLY!
- Buy self out of the remainder of the problems on the page
Learning Contracts

• An agreement between student and teacher – student directed
• Instead of, not in addition to...
• Streamline delivery or eliminate mastered content

<table>
<thead>
<tr>
<th>What</th>
<th>How</th>
<th>When</th>
<th>Proof to self</th>
<th>Proof to audience</th>
</tr>
</thead>
</table>

Anchor Activities

• Self-paced, purposeful, content-driven activities that students can work on independently during a unit or grading period
• Meaningful ongoing activities related to the curriculum
  – A list of activities that a student can do at any time
  – A long-term project
  – An activity center/learning station located in the room
• These activities must be worthy of a student’s time and appropriate to their learning needs

A few possibilities:

• Logic problems
• Pre-algebra thinking activities
• Open-ended math problems
• Figural Analogies
• Spatial Reasoning problems
• Visual Analogies
• Unit projects

Spatial Reasoning Puzzles

CIRCLES:
Using six contiguous straight lines, connect all of the sixteen circles shown below.

Management Suggestions

Explain the activity and the procedures with the whole class

Make expectations clear – develop ground rules for:

Behavior
Performance

Use tasks that require time and thinking – this is not an extension of the “seat-work” concept

Provide clear instructions, materials, responsibilities, check points, and expectations (rubrics)
Think, Pair, Share

• Think about the problem (5 minutes or less)
• Pair up - Share thoughts with a classmate
• Pair up pairs - Share your thoughts

And the problem is....
Create as many problems as you can based on the figure below:

Think-Tac-Toe

• A simple way to give students choices.
• Activities should be structured so that students must grapple with the key ideas and use the key skills central to the topic or area of study

Think-Tac-Toe or Tic-Tac-Toe

Complete question #1 on page 1 in your text.

Argue pro or con: The best way to add mixed numbers is to make them into equivalent improper fractions.

Make up a joke that would help someone remember the steps for subtracting mixed numbers.

Replace the blanks with the digits 1, 2, 3, 4, 5, and 6 and add these fractions:

\[
\frac{1}{2} + \frac{3}{4} + \frac{5}{6}
\]

Think of a situation where you would add fractions in your everyday life.

Someone asks you why you have to get a common denominator when you add and subtract fractions but not when you multiply. What would you say?

Create a subtraction of fractions question where the difference is \( \frac{1}{3} \). Neither denominator you use can be 5. Describe your strategy.

Write the equation of a line that is parallel to this line.

Find the \( x \) and \( y \) intercepts.

Write the linear equation in slope-intercept form.

Write the linear equation in point-slope form.

What is the slope of the line?

Find 2 points on the line (not intercepts).

Write the linear equation in standard form.

Write the equation of a line that is perpendicular to this line.

Draw the graph of the line.
Tiered Activities

Tiered Instruction features:
- Whole group introduction and initial instruction
- Identification of developmental differences
- Increase or Decrease the:
  - Abstraction
  - Extent of Support
  - Sophistication
  - Complexity of goals, resources, activities & products

What constitutes a tiered activity?
- A focus on a key concept – parallel tasks
- Adjust to students’ achievement levels
- Adjust number of steps to the students’ productivity levels
- Students working with appropriately challenging tasks
- Result = Respectable work for everyone
- Students understand why they are all not doing the same thing.

Beginning Probability

Task 1: It’s early Monday morning and your mother has laid out the following clothing items for you to choose from: a red shirt, a blue shirt, a white shirt, blue jeans, and khaki pants. How many different outfits can you make with the clothes your mother has provided?

Task 2: You are making cupcakes for a class celebration. Your classmates have indicated that they would like a choice of different cupcakes. You have: chocolate and yellow cake batter; strawberry, white, and caramel icing; and green and blue sprinkles. How many different types of cupcakes can you offer your classmates?

Vacation Time!

Calculate approximate cost of gas

<table>
<thead>
<tr>
<th>Prompt One</th>
<th>Prompt Two</th>
<th>Prompt Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given cost of gas and mpg of car</td>
<td>Given mpg of car</td>
<td>Asked to approximate cost and justify answer</td>
</tr>
</tbody>
</table>

Family plans to average 50 miles per hour and travel 6 hours per day stopping twice to eat for an hour each time.

How long will it take to get to their destination?
How many nights?
Cost of hotel is about $80 per night. Calculate hotel cost for trip to destination.

How long will it take?
How many nights will they need to spend in hotels?
Calculate hotel cost for trip to destination.

How long? How many nights?
Find hotels that include breakfast. Calculate hotel costs for each day.

How much will it be to get to their destination?
What was a day in the life of one of the mathematicians on your handout. Use the online timeline generator to create a timeline of the events.

GCF Practice
Visit this website to get interactive practice factoring the GCF out of an algebraic expression.

Mathematical Processes
- Algebra: Relationships
- Geometry
- Algebra: Relationships
- Geometry

<table>
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<td>Develop a plan for taking in COC for the concert is $20,000.00. How many tickets must be sold for $10.00 each to make a profit of $16,000.00 for Harbor House?</td>
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</tr>
<tr>
<td>$80.00 each?</td>
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Whole Group Introduction
- Introduction
- Developmental differences
- Initial goals
- Resources
- Complexities
- Assessment

Vacation Time!

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<td>Task 3: You are trying to determine your schedule for next year at Leonard Middle School. First period, you can take art, chorus, or band. Second period, you can take technology or creative writing or be an office assistant. Third period, you can take a foreign language: German, Spanish, French, or Latin. Figure out how many different schedules are possible based on these options.</td>
</tr>
</tbody>
</table>
**Mean, Median and Mode**

- Compute the mean, median, and mode for:
  - Task 1:
    - 2 4 4 6 4 2
  - Task 2:
    - 3 7 8 7 8 2
  - Task 3:
    - 4.2 5 6 8.1 9.3 2.7

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**Tiered Assessments**

Jakarta International School
http://challengebychoice.wordpress.com/examples-of-tiered-math-assessments/

<table>
<thead>
<tr>
<th>Write a variable word phrase for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1: The number of eggs in m dozen</td>
</tr>
<tr>
<td>Tier 2: 5 less than the quotient of 10 and the product of 2 and a number</td>
</tr>
<tr>
<td>Tier 3: Hot water flows at 8.7 liters per minute. Two minutes later you also turn on the cold water, which flows at 13.2 liters per minute. Let x be the number of minutes since you turned on the cold water. Write an expression for the number of liters the hot water has delivered.</td>
</tr>
</tbody>
</table>

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**Remember:**

**Start small**

**Make friends and share**

**Your mantra:**

“Different, not more”

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**CLOSE TO HOME**

**BY JOHN MCPHERSON**

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**THE SECRET BEHIND OLD FAITHFUL**