**Differentiated Instruction**

There is general agreement that to effectively differentiate instruction, the following elements are needed:

* **Big Ideas.** The focus of instruction must be on the **big ideas** being taught to ensure that they are addressed, no matter at what level.
* **Prior Assessment.** Prior assessment is essential to determine what needs different students have.
* **Choice.** There must be some aspect of choice for the student, whether in content, process, or product.

**Teaching to Big Ideas**

Many teachers believe that curriculum requirements limit them to fairly narrow learning goals and feel that they must focus instruction on meeting those specific student outcomes. Differentiation requires a different approach, one that is facilitated by teaching to the big ideas. It is impossible to differentiate too narrow an idea, but it is always possible to differentiate instruction focused on a bigger idea.

**Prior Assessment**

To determine the instructional direction, a teacher needs to know how students in the classroom vary in their mathematical development level. This requires collecting data either formally or informally to determine what abilities or what deficiencies students have. The data derived from prior assessment should drive how instruction is differentiated.

**Choice**

Few math teachers are comfortable with the notion of student choice. They worry that students will not make “appropriate” choices. However, those who are uncomfortable differentiating instruction in terms of the main lesson goal are willing to provide some choice in follow-up activities students use to practice the ideas they have been taught. Some of the strategies that have been suggested for differentiating practice include the use of menus from which students choose from an array of tasks, tiered lessons in which teachers teach to the whole group and vary the follow-up for different students, learning stations where different students attempt different tasks, or other approaches that allow for student choice, usually in pursuit of the same basic overall lesson goal.

It is not realistic for a teacher to try to create 30 different instructional paths for 30 students. The ultimate goal of differentiation is to meet the needs of the varied students in a classroom during instruction. This becomes manageable if the teacher can create a single question or task that is inclusive not only in allowing for students to approach it by using different processes or strategies but also in allowing for students at different stages of mathematical development to benefit and grow from attention to the task.

**Below are some examples of Differentiation Strategies**

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Open Questions

A question is open when it is framed in such a way that a variety of responses or approaches are possible. For example, consider these two questions, each of which might be asked of a whole class.

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| **Question 1:** Write the quadratic  in vertex form.**Question 2:** Draw a graph of. Tell what you notice. |

Question 1 is a fairly closed question. If the student does not know what vertex form is, there is no chance he or she will answer Question 1 correctly. In the case of Question 2, a much more open question, students simply create the graph and notice whatever it is they happen to notice – whether that is the vertex, that the shape is parabolic, that it opens upward, and so on.

Other examples of open questions:

* Graph Does the graph change more if you increase the 6 by 1, the 5 by 1, or the 1 by 1. (This question allows students to predict and then test their predictions. Because this is an opinion question, there is no specific correct answer. Students might draw very different conclusions about which graph changes the most when values of x are near 0 as compared to very large positive or negative values of x.)
* Devon says that he’s thinking of a number that is a rational number when you multiply it by  What do you know about Devon’s number? (To answer this, students must know the difference between rational and irrational numbers and must also realize that if you multiply a rational number by, the result is irrational and not rational. Beyond that, they have many options about what Devon’s number might be or might not be.)
* Two of the vertices of a quadrilateral are and . The other vertices are also in quadrant 1. What kind of quadrilateral could it be? Explain. (By choosing two of the vertices in a horizontal line, the question is made more accessible for some students. Students could easily create a simple rectangle in Quadrant 1. However, other students could be challenged to make more complicated shapes – for example, concave quadrilaterals, trapezoids, kites, or parallelograms. )
* The cosine of an angle in a right triangle, rounded to the nearest thousandth, is 0.707. What might be the dimensions of the triangle? (This question is open in that a student can think of any one of a set of similar triangles.)
* Choose two graphs that show: a) the same kind of data but at different times or places, and b) different kinds of data at the same time or place. (Instead of providing two graphs and having students compare the data, this question has students creating the graphs themselves. The question does not ask for any particular type of graph, thus allowing the students to choose which type of graph is best for comparing the two sets of data they have chosen.)

Open questions can be created relatively easily by strategies such as giving an answer and asking for a question for which it is the answer, allowing students to choose numbers within a question, or asking how two items are alike and different.

Parallel Tasks

Parallel tasks are sets of tasks, usually two or three, that are designed to meet the needs of students at different developmental levels, but that get at the same big idea and are close enough in context that they can be discussed simultaneously. In other words, if the teacher asks the class a question, it is pertinent to each student, no matter which task that student completed.

For example, consider this set of parallel tasks. Students are given the choice to work on option 1 or option 2.

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| Using the expressions for the dimensions given, determine the value of x.Option 1: Option 2: |

Both options require the student to set up a quadratic equation and to find the factors to determine the value of x that is required. With option 1 the student needs to use the Pythagorean Theorem. Option 2 is more straightforward, the student calculates the given area by multiplying the expressions for length and width. Follow-up questions could include: What properties of your shape did you use to help you find the value of x? How did your equation help you find the value of x? Did you verify your value of x? How?

Other examples of parallel tasks:

* Another function is a lot like the given function. What might it be?

Option 1: 

Option 2: 

* Option 1: The answer is  What might the question be?

Option 2: The answer is  What might the question be?

* Option 1: What is the smallest number of triangles into which an n-sided regular polygon can be divided? How do you know? What information about the polygon does that provide?

Option 2: Into how many congruent triangles can an n-sided regular polygon be divided? How do you know? What information about the polygon does that provide?

* Option 1: Why does it make sense that speed is measured in a unit of the form: distance unit / time unit?

Option 2: Why does it make sense that acceleration is measured in a unit of the form: distance unit / time unit2?

* Create a set of data with eight values meeting the stated condition.

Option 1: The mean and median values are the same.

Option 2: The mode and the median are less than the mean.

Multiple Intelligences: One way to better reach all of today’s students is to build lesson plans around the model of multiple intelligences. This model seeks to nurture the broad range of talents in students. It identifies and categorizes eight different intelligences (verbal/linguistic, logical/mathematical, visual/spatial, bodily/kinesthetic, rhythmic/musical, interpersonal, intrapersonal, and naturalist). Curriculum can be created that nurtures these intelligences in students. While it is good to have activities that enhance students’ natural talents, students should also be encouraged to develop their weaker intelligences.

Using CRA (Concrete, Representational, Abstract):

* Concrete: The mathematical concept is modeled using physical objects or manipulatives. These items include buttons, fraction bars, base-ten blocks, beans, sticks, tongue depressors, cubes, place-value mats, chips, golf tees, candy pieces, plates, etc.
* Representational: The concrete model is represented by something pictorial. Representational items include tally marks, lines, dots, number lines, circles, boxes, pictures, etc.
* Abstract: The mathematical concept is shown using graphs or symbols that include numbers, notation, equations, formulas, and operation symbols.

Choices Board: Everyone loves to make his or her own choices. Getting the chance to choose what we want increases the chances that we are actually interested in what we are doing or learning. Choices boards combine both choices and tiering by giving students the opportunities to choose leveled activities from a larger list. There should be at least two of each leveled activity so that students can choose among them. One of the activities should be academically appropriate for the students, while the other activity should challenge the students.

Learning Contracts: Learning contracts are individualized, which means they are different for each student. As a result, students get the chance to work independently. Allow students to choose topics of interest (chosen from a list developed by the teacher). It should be a topic that extends the content areas or is somehow related to studied concepts. Have students fill out a Learning Contract. Meet one-on-one with students to approve their choices or projects. Provide time in class for students to complete their research and study. Let students present their final projects to the class.

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| Remember, just because students are above grade level does not mean they should be given more work. And, just because students are below grade level does not mean they should be given less work. Lessons and assignments are differentiated because of complexity, not necessarily the quantity of work required for that lesson. Likewise, all differentiated activities should be interesting and appealing. |

Differentiation Strategies for Mathematics, Wendy Conklin, Shell Educational Publishing, Inc., 2012

More Good Questions, Great Ways to Differentiate Secondary Mathematics Instruction, Marian Small and Amy Lin, Teachers College Press, Teachers College, Columbia University and National Council of Teachers of Mathematics, 2010

Redefining Fair, How to Plan, Assess, and Grade for Excellence in Mixed-Ability Classrooms, Damian Cooper, Solution Tree Press, 2011