

# Differentiating Mathematics Instruction

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## What Matches You?

- ◆ Ice-breaker
- ◆ Use first week of school
- ◆ Can spark conversations
  - About learning
  - About mathematics
- ◆ Discuss with students different learning modalities and/or multiple intelligences -
  - [www.thomasarmstrong.com/multiple\\_intelligences.htm](http://www.thomasarmstrong.com/multiple_intelligences.htm)
  - [www.slideshare.net/Renegarmath/learning-modalities](http://www.slideshare.net/Renegarmath/learning-modalities)

## Overview

- ◆ Quick overview of what this presentation is all about
  - NCTM Principles and Standards
  - Know Your Students
  - Equity Issues in Mathematics Education
  - Differentiated Instructional Strategies
  - Managing Differentiated Instruction
  - Teaching with the Goal of Differentiation
  - Closing Activity

## NCTM Principles for School Mathematics

- ◆ Equity
  - Excellence in mathematics education requires high expectations and strong support for ALL students
- ◆ Curriculum
  - More than a collection of activities; it must be coherent, focused on important mathematics, and well articulated across the grades
- ◆ Teaching
  - Requires what students know and need to learn, and then challenging and supporting them to learn it well

## NCTM Principles (continued)

- ◆ Learning
  - Students must learn with understanding, actively building new knowledge from experience and prior knowledge
- ◆ Assessment
  - Should support the learning of mathematics and furnish students and teachers with useful information
- ◆ Technology
  - Essential in the teaching and learning of math

## NCTM Standards for School Mathematics

- ◆ 5 Content Standards
  - Number and Operations
  - Algebra
  - Geometry
  - Measurement
  - Data Analysis and Probability
- ◆ 5 Process Standards
  - Problem Solving
  - Reasoning and Proof
  - Connections
  - Communication
  - Representation

Do you see a correlation to P.A.S.S.?

## Know Your Students

- ◆ Math Test What Do They Tell Us?
- ◆ Goal Gather Evidence of Learning for Next Steps – Vygotsky's
- ◆ Questionnaire- Math Connections
- ◆ Journal Activities – Can they Think? Patterns of Thinking?
- ◆ Parental Involvement

## Equity Issues in Math Education

The NCTM specifies that "all students" refers to:

Students who have been denied access in any way to educational opportunities as well as those who have not;

Students who are African Americans, Hispanic/Latino, Native Americans, Alaskan Natives, Pacific Islanders, Asian Americans, First Nations people, and other minorities, as well as those who are considered to be a part of the majority;

Students who are female as well as those who are male;

Students who are from any socioeconomic background;

Students who are native English speakers and those who are not native English speakers;

Students with disabilities and those without disabilities;

Students who have not been successful in school and in mathematics as well as those who have been successful;

In an attempt to address the issue of equity, many school districts have adopted core curricula or an integrated mathematics sequence to ensure that every student in that district has equal access to mathematics that spans the five NCTM content standards.

If all students were truly gaining equal access to the mathematics curricula, to adequate instructional materials and to quality classrooms and teaching, we might expect research on student achievement and career trends to reflect consistency across gender, race, and ethnicity.

Research has shown males tend to outperform females and Caucasian students tend to outperform their non-caucasian peers

One argument proposes that African American students may learn differently than their white counterparts and these differences, historically, have not been addressed academically.

In an NCTM 2000 journal, it was stated that, "equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations are made as needed to promote access and attainment for all students."

Students

with low incomes,

who are female,

who are non-white,

who possess disabilities,

historically, have been victims of low expectations.

## Students with Special Needs

An IEP – Individualized Education Program

- ◆ Describes the nature of the disability
- ◆ Provides a statement of how the disability affects classroom performance
- ◆ Provides a plan for modifications or accomplishments that will be needed for the student to be successful

- ◆ It must specify objectives, goals, and time schedules for achieving them during the school year
- ◆ It must include meetings involving teachers, parents and other school personnel held regularly to revise the plan and to make adjustments

Research shows when abstract mathematical processing usually demonstrated by the teacher is replaced with a physically and visually meaningful mathematical demonstration of the same concept, students with disabilities tend to achieve higher in mathematics.

Once students have an initial concrete experience, they can build on the example by drawing pictures and then abstracting the process with numbers on a page.

This suggests that a “modification” for a student with a learning disability may well be a strategy that is appropriate for all students.

## IDEA - - Individuals and Disabilities Education Act 1975

This was established to ensure that children with disabilities would have access to a free public education that provides the services necessary to meet their individual needs.

This brought about the **inclusion** of students with special needs into a regular classroom.

It was thought to be a positive move, however, when these students were “pulled out” for individual tutoring, it undermined the intention of inclusion which was to get these students to share thinking strategies with peers in their classroom.

Another flaw with inclusion is the lack of consultation between the regular classroom teacher and the special education teacher regarding the needs of students with disabilities.

Consequently, the student with special needs was forced to endure a different type of isolation.

A central philosophy with inclusion is that it is important for special education students to experience the same lessons and classroom environment as their peers.

## Types of Modifications or Accommodations for Meeting the Needs of Students with Disabilities

- ◆ For students who are hard of hearing: wear a special portable microphone to amplify the voice; be sure to directly face the student when speaking;
- ◆ For students who are visually impaired: have a camera the student can use to read notes or view the chalkboard and overhead; enlarge classroom handouts
- ◆ For students with writing disabilities: read test questions out loud; replace written exams with oral exams

- ◆ For students with a reading, writing, or mathematical disability: have the test items read to the students; replace the writing assignments with oral assignments; provide an extended time for taking exams;
- ◆ For students with a behavioral disability: provide active, hands-on experiences; provide regular affirmation and praise for proper performance in the classroom; provide very specific directions about the assignment; provide very specific directions of what is acceptable behavior in the classroom;
- ◆ For students with a disability that affects the timeliness of homework and exam deadlines: modify the amount of work to be done; provide alternate assignments that will address the same objectives; provide extended time on due dates;

- ◆ For students with mathematical computations disabilities: provide appropriate calculators, computers, or other software for the student to use;
- ◆ For students who are gifted: group the student with others who are most likely to challenge this student; provide more stimulating, challenging problems for the student to work;
- ◆ **For the Teacher**: attend professional development workshops in inclusion to learn how to address the needs of students with disabilities.

## Gender

- ◆ “Don’t worry about taking any math classes next year. You’re a young woman, and you plan to go into nursing, so you won’t need pre-calculus anyway.”
- ◆ “The guys in this class should be ashamed of yourselves, allowing a girl to out-perform you.”

Teachers frequently engage in conversations about the differences between the way that males and females learn and how they perform in the classroom.

Here are some examples of gender differences documented with research:

- ◆ As compared to 1990, in 2007, both sexes experienced higher scores on the NAEP mathematics tests.
- ◆ Approximately two-thirds of eighth graders, for both male and female students, were taking a regular eighth grade mathematics or pre-algebra course.
- ◆ Three out of five members of the National Honor Society are females.
- ◆ More females than males take advanced placement courses.

- ◆ Females spend more time on homework and less time watching television than do males.
- ◆ When males perform a task, they tend to attribute their successes or failures to their ability levels.
- ◆ When females perform a task, they tend to attribute their performance levels to good or bad luck.
- ◆ In career areas where mathematical skills predicate employment, males dominate, with females making up about 15% of the workforce.
- ◆ Traditional means of teaching mathematics is generally not compatible with the learning styles of most females.

The major point here, is that there is a difference between how males and females learn.

Teachers of mathematics need to be sensitive to these differences and to conduct the teaching and learning process in such a way that equity among genders is promoted.

For example: students should have the opportunity to explore professions and the qualifications required for those jobs while still in middle or high school.

Teachers should invite guest speakers to mathematics classes to describe their jobs and explain the role mathematics has in their day-to-day situations.

Teachers should have the students select a career area of interest and explore it in detail. As part of the project, the student is asked to carefully consider the mathematics requirements to the profession.

## In the classroom, teachers can serve female students well by:

- ◆ affirming their performances and helping them build confidence that they are truly developing mathematical competence.
- ◆ providing cooperating learning settings that promote interaction among peers because research shows that females prefer working with peers (rather than competing against them) and tend to achieve at higher levels in a collaborative environment.
- ◆ be sensitive to gender differences in order to promote equity, infusing the idea that mathematics is for all students and that career areas are accessible to both females and males.

## Ethnic and Cultural Issues

- ◆ Students of color and those from lower socioeconomic settings tend to be taught by teachers who do not believe these students can succeed, and the students' achievement test scores are consistently lower than the scores of their Caucasian peers.

Research indicates that educators have known for decades that the curriculum and classroom settings cater primarily to the needs of middle- and upper-class white students, but we continue to see little progress in improving the situation for students of other colors and cultures.

In response to this, NCTM published, between 1999 and 2000, an entire series of books called *Changing the Faces of Mathematics*, which include the following volumes: *Perspectives on African Americans*, *Perspectives on Asian Americans and Pacific Islanders*, *Perspectives on Indigenous People of North America*, *Perspectives on Latinos*, and *Perspectives on Multiculturalism and Gender Equity*.

In the book *Perspectives on Indigenous People of North America*, one article describes the clear connections between the cultural beliefs of the Native American  
And  
the constructivist philosophy of teaching and learning.

It was pointed out that Native Americans prefer lessons that can be applied to their real lives and that the bonding of family members can be simulated through cooperative learning activities in the classroom.

The idea is to make the study of mathematics relevant and meaningful to the child by connecting activities to the life and culture of the community.

African American students are often placed  
in low-level mathematics classes  
and are taught by individuals  
who do not believe these students can achieve  
significant mathematical understanding.

## Teachers of African American Students Should:

- ◆ focus on conceptual understanding.
- ◆ let your students know that you believe they are capable of learning mathematics.
- ◆ use mathematics to explore issues related to race and ethnicity.
- ◆ promote an atmosphere in the classroom in which students justify their thinking and challenge other students' responses.
- ◆ develop partnerships with the parents of these students.

As is the case with all students, the teacher who possesses a deep understanding of the students that are being taught will be more likely to enter their world and have a significant impact.

Building bridges with these students and their families can ultimately raise achievement levels, which in turn may result in new career opportunities for populations that historically have been underrepresented in the professional workforce.

## What is differentiated instruction?

- ◆ Differentiated instruction is a process by which teachers adapt their teaching strategies in an attempt to meet the diverse needs of students who possess a variety of academic, socioeconomic, cultural, and racial backgrounds.
- ◆ It implies the use of a variety of teaching techniques and assessment methods to meet student needs.

## Strategies of DIFFERENTIATED INSTRUCTION

### K-4

- ◆ Identify important mathematical skills and concepts
- ◆ Teach vocabulary
- ◆ Assess what students know, what interest them, and how they learn best
- ◆ Create diverse tasks through which students can build understanding and demonstrate what they know
- ◆ Use the three modalities and student preferences
- ◆ Design and modify tasks to meet students' needs
- ◆ Provide students with choices to make
- ◆ Manage different activities taking place simultaneously
- ◆ Group or cooperative learning activities – student choices?
- ◆ Make connections among mathematics and other subjects and students' interest
- ◆ Provide a variety of ways in which students can show their understanding (Dacey & Salemi, 2007)

### 5-8

- ◆ Use a variety of teaching techniques
- ◆ Emphasize critical thinking
- ◆ Use a variety of assessment strategies
- ◆ Do not simply ask students to solve additional problems, do an extra report, or play computer games when they finish early
- ◆ Play into students interests
- ◆ Use active teaching techniques that allow students to explore and draw their own conclusions
- ◆ Have students work in cooperative groups
- ◆ Encourage individual research
- ◆ Use multiple representations to illustrate problem-solving strategies
- ◆ Differentiate tasks and assignments
- ◆ Provide extra assistance to those who need it
- ◆ Provide challenges for those who are high achievers

## 9-12

- ◆ Teach vocabulary
- ◆ Make use of cooperative learning and group activities
- ◆ Explore worthwhile, relevant tasks
- ◆ Use multiple representations
- ◆ Integrate technology
- ◆ Emphasize *dialogue* over lecture
- ◆ Make content connections between math and across subjects
- ◆ Use various presentation styles
- ◆ Communicate high expectations and have students set goals for themselves
- ◆ Involve parents and community members
- ◆ Vary assessment strategies

## Managing the Process

- ◆ Consider a “student-centered” rather than “teacher-centered” classroom
- ◆ As a teacher, you “coach” the whole group, identified subgroups, and individuals
- ◆ Items to consider
  - Classroom space/furniture
  - Grouping students for collaborative work
  - Managing instruction time and “ragged” time
    - ◆ One-on-one time, group work, whole-class work
    - ◆ Math “workshops”, learning stations vs. learning centers
  - Assessment strategies

## When designing lessons, consider:

- ◆ What is the mathematics I want my students to learn?
- ◆ What do my students already know? What is my evidence of this? How can I build on their thinking?
- ◆ How can I expand access to this task or idea? Have I thought about interests, learning styles, uses of language, cultures, and readiness?
- ◆ How can I ensure each student experiences challenge?
- ◆ How can I scaffold learning to increase the likelihood of success?
- ◆ In what different ways can my students demonstrate their new understanding?
- ◆ Are there choices students can make?
- ◆ How prepared am I to take on these challenges?

## Teaching With the Goal of Differentiation

### Ten ways to sustain your efforts

- ◆ Identify Where You Already Do Differentiation
- ◆ Understand and Recognize Where You Are
- ◆ Start Small (Task that are chewable) and Build Up
- ◆ Think Ahead- Anticipation
- ◆ Expect Surprises – So What if it does not always go as planned? Did they learn?
- ◆ Students Can Help
- ◆ Involve Parents
- ◆ Professional Development
- ◆ Reflect
- ◆ Keep Trying – the little engine- (Dacey & Lynch, 2007)

## Closing Activity

- ◆ Self-Assessment of Differentiation Practices

## References

- ◆ Brahier, Daniel J. (2009). *Teaching Secondary and Middle School Mathematics*. Pearson Education, Inc.: Boston, MA.
- ◆ Dacey, L. and Lynch, B. (2007). *Math for All: Differentiating Instruction, Grades 3-5*. Math Solutions Publications: Sausalito, CA.
- ◆ [www.nctm.org](http://www.nctm.org)