
 **ADVANCING RESEARCH, IMPROVING EDUCATION**

## Research: Differentiating Algebra Instruction in High School

**Response to Intervention: Tiered Interventions and Evidence-Based Strategies for Improving Student Outcomes in High School Summit**


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 **ADVANCING RESEARCH, IMPROVING EDUCATION**

## Differentiating Algebra Instruction in High School

### Objectives

1. Investigate current research on differentiating Algebra instruction in high school.
2. Examine differentiated instruction in the larger context of improving mathematics education and student achievement.

## Focus on Differentiation

### Step One

You will be shown an object. In pairs or groups of 3, your task is to list all that you can about attributes of this object based on what you can determine using all 5 of your senses (sight, touch, etc.).

## Focus on Differentiation

### Step Two

You will be shown a second object. Your task is to line out or eliminate from your list any attributes that no longer hold true or cannot be determined.

## Focus on Differentiation

### Step Three

You will be shown a third object. Your task is to line out or eliminate on the original list any attributes that no longer hold true or cannot be determined.

## Focus on Differentiation

### Step Four

You will be shown a fourth object. Your task is to line out or eliminate on the original list any attributes that no longer hold true or cannot be determined.

## Focus on Differentiation

### Step Five

The pattern continues with the facilitator providing one more context for the original object. Your task is to line out or eliminate on the original list any attributes that no longer hold true or cannot be determined.

## Focus on Differentiation

- Based on this activity, what are the implications for mathematics instruction, in particular with respect to differentiation?
- Discuss with a partner and be prepared to share with the group.

## High School Algebra: Differentiated Instruction Research

- Specific scientifically-based research on differentiated Algebra instruction at the secondary level is presently non-existent.
- Algebra-specific scientifically-based research within topics such as RtI (Response to Intervention) is extremely limited.

## Lack of Differentiated Instruction Research

### Example

The problem is that there are no agreed upon general outcome measures for high school math, and most progress monitoring measures for math are based on basic computation, which technically should be mastered by the 7<sup>th</sup> or 8<sup>th</sup> grade (page 5).

(Southeast Comprehensive Center, 2009)

## Lack of Differentiated Instruction Research

### Example

There is a need to develop predictive theory for what combinations of assistance yield the most effective and efficient learning.

Exploring the combined affect of worked examples and tutors—and how the two types of assistance differ from and/or complement one another—is still an open scientific question.

(McLaren, Lim, & Koedinger, 2008)

## Lack of Differentiated Instruction Research

### Example

The Final Report of the National Mathematics Advisory Panel reviewed more than 16,000 research publications and policy reports, in addition to written commentary from 160 organizations and individuals. Very few met their standards for SBR (scientifically-based research).

## Differentiated Instruction Available Research

- The lack of specific SBR on differentiated algebra instruction necessitates that we rely on what research is available and on professional wisdom.
- Much of what is available is not algebra or mathematics specific.

## Differentiated and Traditional Instruction

Historically schools in the United States have been run on a factory model where all students learn the same way and should achieve the same goals.

(Baglieri & Knopf, 2004)

## Differentiated and Traditional Instruction

In most of today's classrooms there is a wide range of student abilities, which makes it necessary for teachers to reevaluate their primary role in the classroom as being the distributor of information.

(Scholz, 2004)

## Differentiated and Traditional Instruction

Differentiation is designing lesson plans, projects, assessments, and learning environments to accommodate the individual readiness, interests and learning profile of each student.

(George, 2005; Powell & Napoliello, 2005; Tomlinson, 1999; Tomlinson 2000; Tomlinson 2005)



## Differentiated and Traditional Instruction

The pedagogical theory that guides differentiation is constructivism: *the belief that learning happens when the learner makes meaning out of information.*

(Benjamin, 2002, p. 1)

## Differentiated and Traditional Instruction

- It stands to reason that effective differentiated instruction is partially grounded on research that has yielded “best practices” in current instruction.
- The key difference is the focus and realization that each student is unique and thus requires special attention and adaptation of learning experiences to fit those unique needs, interests, attitudes, and abilities.

(George, 2005)

## Differentiated Instruction

- Differentiated instruction includes strategies to adjust the content that is taught, the processes used to teach that content, and the student products used to determine their level of understanding.

(Northey, 2005)

## Available Algebra Research: Key Findings

There is the need for differentiated Algebra I instruction for gifted learners. Teachers should ensure that gifted learners receive appropriately advanced or differentiated instruction so that these students' abilities are reflected in their academic achievement.

(Matthews & Farmer, 2008)

## Available Algebra Research: Key Findings

There is a need for the increased use of class discussion in algebra courses. Rather than reliance on traditional lecture-based instruction, teachers should incorporate more classroom discussion on mathematical topics.

(Matthews & Farmer, 2008)

## Available Algebra Research: Key Findings

Teachers at the high school level indicated they were unsatisfied with the idea of “teaching to the middle” because this leads to a lack of challenge for the advanced students, while it frustrates the lowest students who usually end up needing a re-teaching lesson anyway.

(Ellis, D., Ellis, K., Huemann, L. & Stolarik, E, 2007)

## Available Algebra Research: Key Findings

A concern mentioned at the high school level was how to grade fairly. For example, should grades be based upon effort or performance?

(Ellis, et al.)

A majority of teachers felt they lacked the knowledge, tools, and support to differentiate math instruction.

(Ellis, et al.)

## Differentiated Instruction: Reality

By the time students reach high school, there may be five different ability levels for mathematics that students are already tracked into. Research suggests that tracking demonstrates no academic gain and even causes a wider gap between high and low students.

(Johnson, 1999).

## Differentiated Instruction: Reality

The reason one-size-fits-all classrooms continue is that teachers lack the exposure and the knowledge to incorporate differentiated instruction.

(Edgemon, Jablonski & Lloyd, 2006; Holloway, 2000; Tomlinson, 2005).

Teachers are not adequately prepared by universities for the variety of abilities and skill levels that are found in today's classrooms.

(Holloway, 2000).

## Differentiated Instruction: Reality

Practicing teachers need training on how to address the varying learning styles, interests, and abilities of the students in their classrooms so they can implement differentiated instruction.

(Pettig, 2000; Wehrmann, 2000; Tieso, 2004)

## Differentiated Instruction: Reality

Many educators are uncomfortable with the idea of change, making this transition to differentiate instruction more challenging (George, 2005).

Asking teachers to differentiate instruction and modify the school curriculum to meet the needs of their learners takes them out of their comfort zone and questions regarding classroom management and fairness arise (VanTassel-Baska & Stambaugh, 2005).

## Differentiated Instruction: Reality

The biggest problem that teachers face when they implement differentiated instruction is planning time (Ellis, et al.).

Many teachers become overwhelmed and frustrated when thinking about the time and effort to plan differentiation (Powell & Napoliello, 2005; VanTassel-Baska & Stambaugh, 2005).

## Differentiated Instruction: Reality

- Think back to the pear activity.
- Even with the real pear and the use of effective instructional strategies, there is still the real-world necessity of *knowing the students*.

## Differentiated Instruction: Reality

The benefits of taking the time to create genuine teacher-student relationships are immeasurable. Never underestimate the importance of human relationships in learning (Baglieri & Knopf, 2004).

The reality of the high school mathematics teacher—How can one teacher *know* 100 to 150 students, much less be able to align content, instruction, and assessment to meet their individual needs? (Northey, 2005)

## Differentiated Algebra Instruction

- In mathematics, a non-linear function does not have a constant slope, but rather different rates of change.
- The analogy in education would be that learning is not a linear function. Students learn at different rates with each using his or her own “equation” that is dependent on previous experience, learning style, etc.

## Differentiated Algebra Instruction

- In mathematics (calculus), differentiation gives us the power to determine the rate of change for a function at any given point.
- The analogy in education would be that differentiation enables us to determine the “rate of change” in student learning at any given point. Teachers gauge student thinking and make appropriate instructional decisions and adjustments.



## Differentiated Algebra Instruction

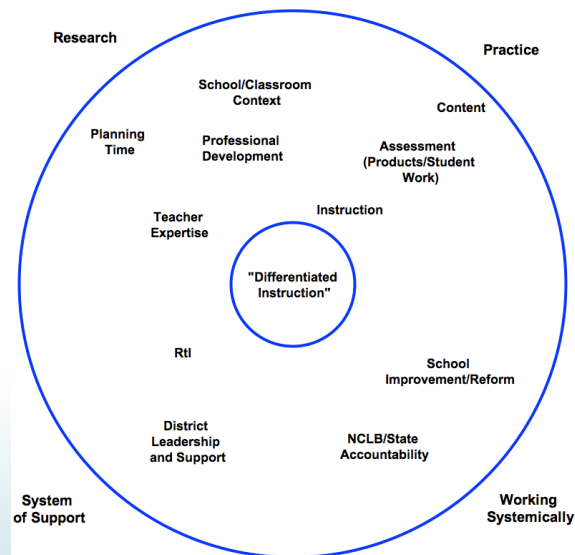
- From both research and practice perspectives, the existence of multiple variables makes differentiated instruction a complex endeavor.
- Refer to the handout “Classroom Practices”.
- Appropriate focus for teachers.

## Differentiated Algebra Instruction

- Refer to the handout “Example of a Think Aloud”.
- Read and determine if there is anything problematic with the strategy or the probable outcome.
- Discuss with a partner and be prepared to share with the group.

## Differentiated Instruction: The Big Picture

- Differentiated instruction is one piece of a much larger puzzle.
- Refer to the “Big Picture” handout. Keeping in mind your roles as state-level leaders in education, examine the components of the diagram.



## Differentiated Instruction: The Big Picture

### Think-Pair-Share

- How does your state department address, link, leverage, or support implementation of these components associated with differentiation of secondary mathematics instruction?
- What can you do in your role or sphere of influence to address the implementation of differentiated mathematics instruction and related components?

## Resources

Center on Instruction: Math Strand

[http://centeroninstruction.org/resources.cfm?  
category=math&subcategory=&grade\\_start=&grade\\_end=](http://centeroninstruction.org/resources.cfm?category=math&subcategory=&grade_start=&grade_end=)

Center on Instruction: RtI

[http://centeroninstruction.org/resources\\_searchresults.cfm?  
searchterms=Response%20to%20Intervention&explicit=1](http://centeroninstruction.org/resources_searchresults.cfm?searchterms=Response%20to%20Intervention&explicit=1)

Note. See handout for bibliography of cited sources.

## Resources

National Center on Response to Intervention:

<http://www.rti4success.org/>

Institute of Education Sciences (IES):

<http://ies.ed.gov/>

National High School Center:

<http://www.betterhighschools.org/>

## Differentiated Instruction in Real Life

- Research is essential and informs the decision-making process.
- Translating research to practice is key.
- What does high school differentiated algebra instruction look like in real life?