All Students Engaging in the Math Process Standards: Advanced and Gifted Students in Mathematics

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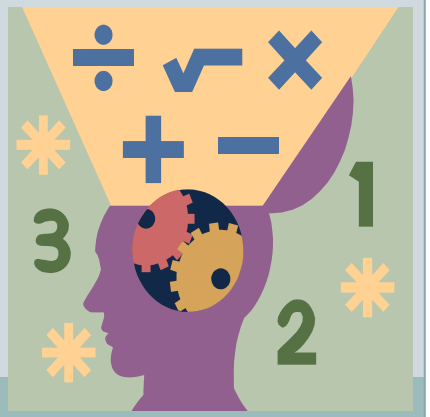
SOUTHERN METHODIST UNIVERSITY

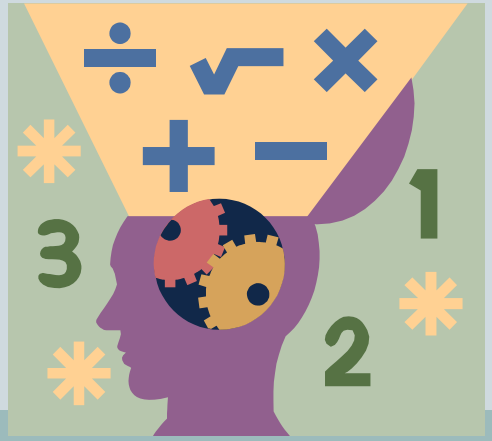
Characteristics of Advanced and Gifted Learners in Mathematics

- Is interested in numerical analysis
- Appreciates parsimony, simplicity or economy in solutions
- Is precocious in making sense of problems
- Stores the main features of problems and solutions
- Organizes data to discover patterns or relationships



Characteristics of Advanced and Gifted Learners in Mathematics

- Has a faster pace of learning (2-3 repetitions)
- Solves problems intuitively; using insight
- Is an efficient and effective problem solver
- Can reverse steps in mental process
- Improvises with math methods
- Is flexible in solving problems



Mathematical Process Standards

Apply mathematics to everyday problems

Use a problem solving model

Select tools, technology, and techniques as appropriate

Communicate mathematical ideas, reasoning, and their implications using multiple representations

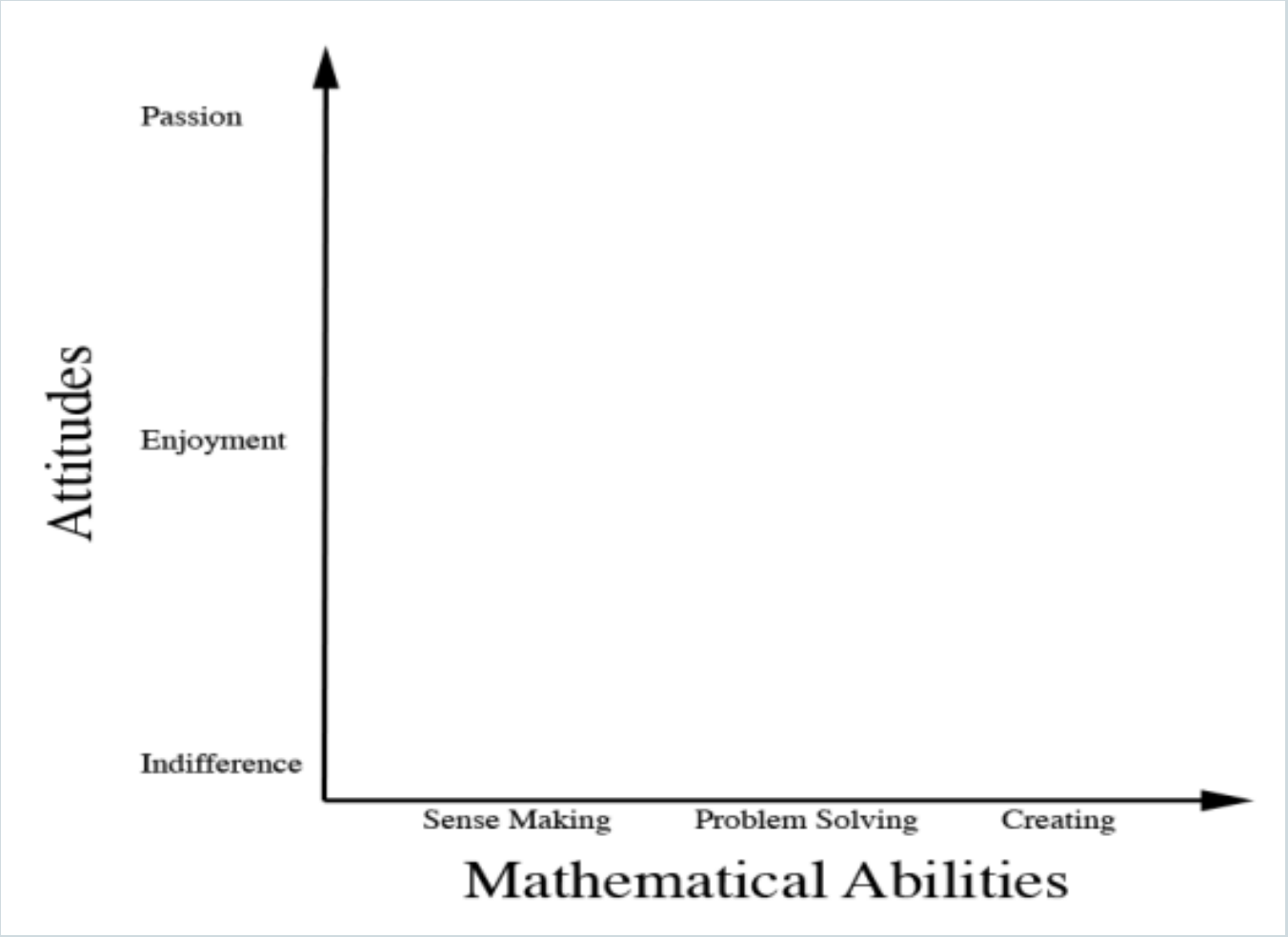
Analyze mathematical relationships to connect and communicate

Display, explain, and justify mathematical ideas and arguments using precise mathematical language

Create and use representations to organize, record, and communicate

**Solve problems in novel ways and pose new mathematical questions of interest to investigate

Developing Creative and Passionate Mathematicians (Gavin & Sheffield, 2010)



Learning Progressions

Vertical and lateral alignments within the standards:

- Vertical (measurement and data to probability to mathematical models and statistics)
- Horizontal (Grade 4-TEKS) (Measurement and Data: measures length, area, volume/capacity, weight/mass, time, temperature, angles; converts units of measure; compares measurable attributes; applies measurement to problem solving)

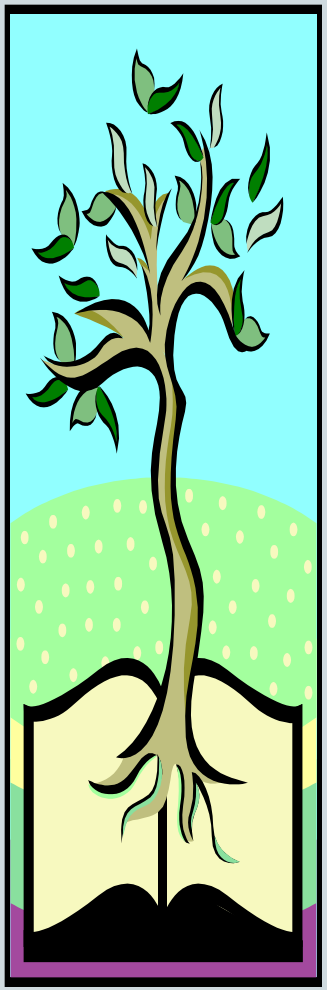
Learning Progressions

- Helps teachers identify what is expected and the key points along the path that indicate growth in knowledge and skills

- No set of standards reflects the great variety in abilities and learning levels of students in a given classroom

Learning Trajectory

- Trajectory is based on how each student's thinking grows in response to learning experiences. Key interventions influence each student's learning progression.
- Advanced or gifted learners may proceed through learning progressions in a different sequence and at a different pace than their peers.



Top 10 Strategies for Differentiating Mathematics for Advanced Learners

Differentiating Mathematics

1. Use balanced assessments to determine pacing and acceleration.

2. Group students with similar interests and abilities.

Example:

Based on assessments, small groups of first grade students might be estimating lengths using standard units while others might be solving problems involving measurement and estimation (Grade 3) or converting measurement units (Grade 5)

Differentiating Mathematics

3. Integrate greater complexity and depth in problems by including:

- abstract concepts (“patterns”)
- steps that involve one or more operations
- novel situations
- information that is not relevant to solving the problem
- advanced vocabulary
- trends and patterns

Differentiating Learning Experiences: Complexity and Depth

Example Problem: In preparing for a math state assessment, students want to improve their overall performance on basic facts.

Both typical and advanced students predict results, collect data on fluency in basic facts, create a line plot to display the data (using fractions), and interpret the results. Advanced students create a double/triple line-plot graph and make comparisons, discussing trends. They plan and implement possible interventions to improve performance.

Differentiating the Learning Experiences

4. Focus on broader concepts.

Example: Students examine the concept of “order” by identifying situations in which the order in data communicates a concept, collecting examples of situations in which ordered data have allowed for predictions, establishing criteria to distinguish between examples of natural and constructed order and/or by speculating on ways in which random occurrences might be used to form new concepts of order.

Differentiating the Learning Experiences

5. Incorporate more creativity in problem solving by having students use:

- different methods and solutions (fluency)
- different categories of methods or solutions (flexibility)
- more precision and detail in representing data (elaboration)
- new data-gathering instruments; solutions that show insight; their own questions (originality)

Differentiating the Learning Experiences

6. Ask higher level questions.

Examples:

Who? Who has another solution? Another method?

What or what if? What patterns do I see in these data?

When? When does this work? Not work?

Where? Where should I start? Where might I find additional information?

Why or why not? Why does that work?

How? How is this like other mathematical problems?

Differentiating the Learning Experiences

7. Use the same processes mathematicians might use.

Example:

Teachers might present more complex problems as a challenge (not for a grade or course credit) to try and solve over longer periods of time.

Differentiating the Learning Experiences

8. Create authentic interdisciplinary problem-solving opportunities.

Example:

In the social sciences, students might estimate the population of their school, the city, the state, the U.S., and other countries to predict future population growth.

Differentiating the Learning Experiences

9. Identify collaborators.

Example: Students might collaborate on complex problems with mathematicians in higher education or within the business community not only to develop expertise but also to introduce the student to professional networks and work habits that are required in a professional field.

Differentiating the Learning Experiences

10. Engage students in outside-of-school opportunities.

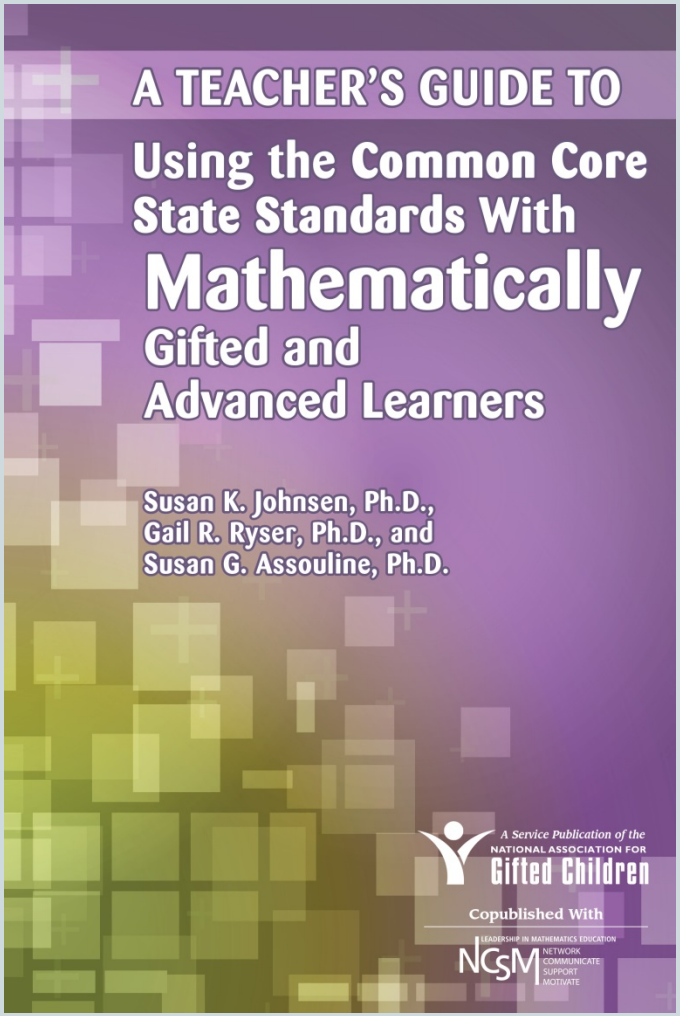
Examples:

Talent Search Programs
International Mathematical Olympiad
Intel Science Talent Search
MathCounts
American Mathematics Competitions

Conclusions

- Gifted and advanced students demonstrate specific characteristics.
- They need opportunities not only to develop their mathematical abilities but their passion for mathematics.
- They will progress through the mathematical content at a different pace and in a different sequence.
- Teachers need to use balanced assessments to differentiate learning experiences for these students.

Resources


A TEACHER'S GUIDE TO
Using the Common Core State Standards With
Mathematically
Gifted and Advanced Learners
Susan K. Johnsen, Ph.D.,
Gail R. Ryser, Ph.D., and
Susan G. Assouline, Ph.D.
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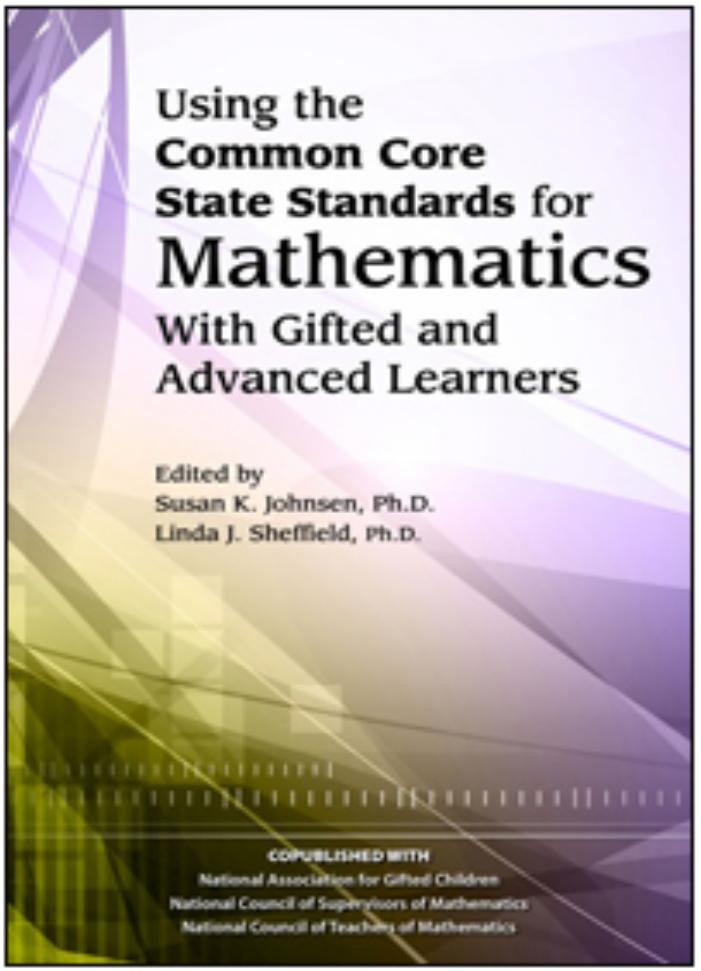
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It must be remembered that the purpose of education is not to fill the minds of students with facts, it is not to reform them, or amuse them, or to make them expert technicians in any field. It is to teach them to think, if that is possible, and always to think for themselves.

Robert Hutchins