IES Practice Guide (May 2012): Improving Mathematical Problem Solving in Grades 4 Through 8

**Recommendation 1.** Prepare problems and use them in whole-class instruction.

1. Include both routine and non-routine problems in problem-solving activities.

___________________________________________________________________________

___________________________________________________________________________

2. Ensure that students will understand the problem by addressing issues students might encounter with the problem’s context or language.

___________________________________________________________________________

___________________________________________________________________________

3. Consider students’ knowledge of mathematical content when planning lessons.

___________________________________________________________________________

___________________________________________________________________________

**Recommendation 2.** Assist students in monitoring and reflecting on the problem-solving process.

1. Provide students with a list of prompts to help them monitor and reflect during the problem-solving process.

___________________________________________________________________________

___________________________________________________________________________

2. Model how to monitor and reflect on the problem-solving process.

___________________________________________________________________________

___________________________________________________________________________

3. Use student thinking about a problem to develop students’ ability to monitor and reflect.

___________________________________________________________________________

___________________________________________________________________________
**Recommendation 3.** Teach students how to use visual representations.

1. Select visual representations that are appropriate for students and the problems they are solving.

   ____________________________________________________________________________

   ____________________________________________________________________________

2. Use think-alouds and discussions to teach students how to represent problems visually.

   ____________________________________________________________________________

   ____________________________________________________________________________

3. Show students how to convert the visually represented information into mathematical notation.

   ____________________________________________________________________________

   ____________________________________________________________________________

**Recommendation 4.** Expose students to multiple problem-solving strategies.

1. Provide instruction in multiple strategies.

   ____________________________________________________________________________

   ____________________________________________________________________________

2. Provide opportunities for students to compare multiple strategies in worked examples.

   ____________________________________________________________________________

   ____________________________________________________________________________

3. Ask students to generate and share multiple strategies for solving a problem.

   ____________________________________________________________________________

   ____________________________________________________________________________

**Recommendation 5.** Help students recognize and articulate mathematical concepts and notation.

1. Describe relevant mathematical concepts and notation, and relate them to the problem-solving activity.

   ____________________________________________________________________________

   ____________________________________________________________________________

2. Ask students to explain each step used to solve a problem in a worked example.

   ____________________________________________________________________________
3. Help students make sense of algebraic notation.

Five Strands of Mathematical Proficiency (NRC, 2002)

1. **Understanding:** Comprehending mathematical concepts, operations, and relations—knowing what mathematical symbols, diagrams, and procedures mean. [Conceptual Knowledge]

2. **Computing:** Carrying out mathematical procedures, such as adding, subtracting, multiplying, and dividing numbers flexibly, accurately, efficiently, and appropriately. [Procedural Knowledge]

3. **Applying:** Being able to formulate problems mathematically and to devise strategies for solving them using concepts and procedures appropriately. [Metacognition]

4. **Reasoning:** Using logic to explain and justify a solution to a problem or to extend from something known to something less known. [Synthesis]

5. **Engaging:** Seeing mathematics as sensible, useful, and doable—if you work at it—and being willing to do the work. [Motivation/Self-Efficacy]

Reference

### How Do We Reach Low-Performing Math Students?: Instructional Recommendations

**Important elements of math instruction for low-performing students** (Baker, Gersten, & Lee, 2002; p. 51):

<table>
<thead>
<tr>
<th>IDEAS FOR IMPLEMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Providing teachers and students with data on student performance</strong></td>
</tr>
<tr>
<td><strong>Using peers as tutors or instructional guides</strong></td>
</tr>
<tr>
<td><strong>Providing clear, specific feedback to parents on their children’s mathematics success</strong></td>
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<tr>
<td><strong>Using principles of explicit instruction in teaching math concepts and procedures.</strong></td>
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</tbody>
</table>

### Reference

**Worksheet: Identifying a Student Academic Problem**

1. **Describe the problem.** Think of a student currently or previously in your class whose academic problem(s) require significant amounts of your time, energy, and support. In 1-2 sentences, briefly describe the nature of that student's academic problem(s).

   **Description of student academic problem(s)**

2. **Write a 3-part Problem-Identification Statement.** Use this organizer to rewrite your student's academic problem in the form of a 3-part Problem ID statement. For examples, see pp. 5-6 of handout:

   **3-Part Academic Problem ID Statement**
<table>
<thead>
<tr>
<th>Environmental Conditions or Task Demands</th>
<th>Problem Description</th>
<th>Typical or Expected Level of Performance</th>
</tr>
</thead>
</table>

3. **Write a Hypothesis Statement.** Based on your knowledge of this student, write a 'hypothesis' statement that pinpoints the likely 'root cause' of the academic problem. See the next page for a listing of possible hypotheses.

   **Hypothesis Statement**
The Math-Challenged Student: Profile

Use this list of common challenges of students who struggle with mathematics to identify specific obstacles faced by learners in your classroom.

<table>
<thead>
<tr>
<th>Area of Math Challenge: The student…</th>
<th>Strategies to Address Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. has problems with short-term memory.</td>
<td></td>
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<tr>
<td>2. has difficulty understanding math concepts/abstractions.</td>
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<tr>
<td>3. possesses a limited attention span (difficulty remaining on-task).</td>
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<tr>
<td>4. has difficulty with spatial awareness.</td>
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<tr>
<td>5. fails to apply previously learned knowledge.</td>
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<tr>
<td>6. is unable to apply math concepts/reasoning to real-life situations.</td>
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<tr>
<td>7. struggles with visual sequencing—the ability to see objects in a sequential order (e.g., copying from the board, sequencing numbers, etc.)</td>
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<tr>
<td>8. confuses various math signs and symbols.</td>
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<td>9. has deficits in math-related vocabulary.</td>
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<td>10. has limited reading skills.</td>
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<td>11. has difficulty following directions.</td>
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<td>12. easily becomes overwhelmed with new learning</td>
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</table>

Reference