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## Problem-based Instructional Tasks

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## Problem-based Instructional Tasks

by Larry Leutzing

Presenting problem-based instructional tasks and asking students to explain their thinking results in higher overall achievement.

Tasks that ask students to perform a memorized procedure in a routine manner lead to one type of opportunity for student thinking; tasks that require students to think conceptually and that stimulate students to make connections lead to a different set of opportunities for student thinking. The day-in and day-out cumulative effect on classroom-based tasks leads to the development of students' implicit ideas about whether mathematics is something about which they can personally make sense and about how long and how hard they should have to work to do so.

Evidence gathered across scores of middle school classrooms has shown that students who performed the best on project-based measures of reasoning and problem solving were in classrooms in which tasks were more likely to be set up and *implemented* at high levels of cognitive demand. For these students, having the opportunity to work on challenging tasks in a supportive classroom environment translated into substantial learning gains on an instrument specially designed to measure exactly the kind of student learning outcomes advocated by NCTM's (National Council of Teachers of Mathematics) professional teaching standards. (Stein and Smith, 1998)

### References:

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- Stein, M. K., & Smith, M. (1998). Mathematical tasks as a framework for reflection: From research to practice. *Mathematics Teaching in the Middle School*, 3(4) 268-275.

## **Characteristics of Problem-based Instructional Tasks**

- Help students develop a deep understanding of important mathematics
- Are accessible yet challenging to all students
- Encourage student engagement and communication
- Can be solved in several ways
- Encourage the use of connected multiple representations
- Encourage appropriate use of intellectual, physical and technological tools

## **Lesson Format for Problem-based Instructional Tasks**

### **Launch: (Teacher)**

- Discuss appropriate vocabulary
- Have students explain their understanding of the problem
- Provide a “mini” problem\*

### **Explore: (Students)**

- Work individually, in pairs, and/or in groups
- Agree on the solution
- Ask clarifying questions (students and teacher)

### **Share: (Students)**

- Provide a variety of answers or solution strategies
- Explain their thinking and justify their responses
- Ask questions or add comments

### **Summarize: (Teacher)**

- Emphasize the key points involved in the problem solution
- Ask students questions related to the problem
- Clarify effective thinking strategies

### **Extend: (Teacher)**

- Provide practice activities that emphasize use of effective strategies
- Look at the problem in a slightly different way
- Use different numbers or vary the instructions

### **Creating a Mini Problem to Preview a Difficult Task**

1. Read over the problem (task).
2. Create another problem (task) that contains the essential ingredients of the original problem but is easier to solve.
3. Present the original problem (task) to the students and highlight how the sample problem relates to this problem.
4. Highlight how the sample problem (task) is different from the original.
5. Have the students work in pairs or groups to solve the original problem (complete the task).

### **Making a Routine Lesson a Problem-based Lesson**

- Turn the page around. Start with the last problems on the page.
- Solve the introduction problem without showing or telling the student what to do.
- Use the manipulatives recommended on the page, but have the students represent the situations on their own.
- Make a game of the problem on the page. Require decision-making and reasoning.
- Do aspects of the page mentally.
- Differentiate the task for individual students.

**The students should be the ones representing and solving problems, not watching or reading how someone else solved a problem. The overarching goal is to have the students develop thinking strategies while “doing mathematics.”**

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