

Teaching Authentic Problem Solving

DEVELOPING GREATER MATHEMATICAL REASONING WITH STUDENTS



What challenges do students have when asked to complete application problems in your classroom?

Resources referenced in this professional development:

blog.mrmeyer.com

www.mathalicious.com

https://www.ted.com/talks/dan_meyer_math_curriculum_makeover

Algebra Problems: One Step Beyond by Reuben Schadler

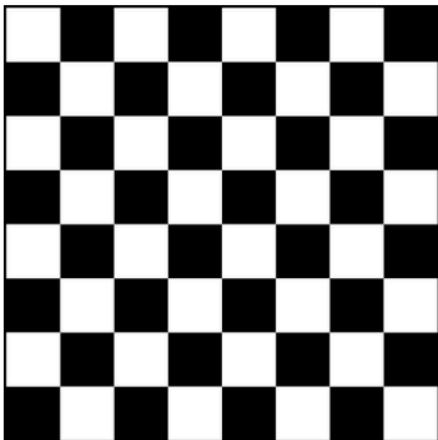
When learning word problems, students are often

- presented with all information before knowing the question to be answered
- told in advance the formula needed to solve a formula-based word problem
- asked to identify what information is necessary *before* having determined the **process** needed to answer the question.
- given a set of steps to follow and an almost identical example of what they will later be asked to do independently.
- rarely given opportunities to dialogue about the process and the math involved

All of these common practices hinder students' development in important reasoning and critical thinking skills necessary for problem-solving.

sample problems that can be used to promote student discourse and reasoning

How many squares can be found on a chessboard?



Using only the symbols $+$, $-$, \times , and \div as replacements for the blanks, find the greatest value of the expression given.

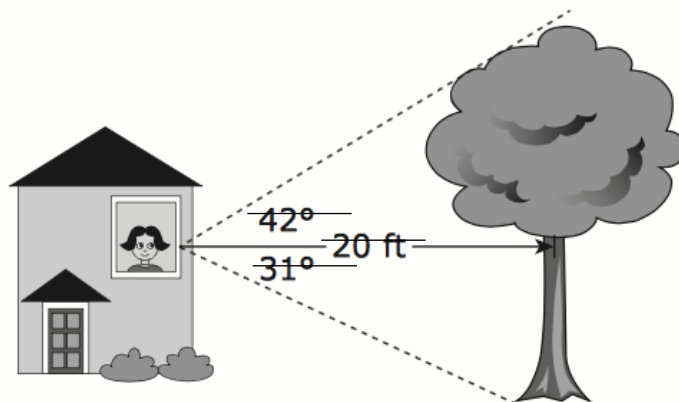
1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ 7 ____ 8

When Amy was asked to count the number of tricycles and bicycles in her mother's bicycle shop, she got bored. Rather than just counting the vehicles, she decided to count the number of pedals and the number of wheels. She counted 132 wheels and 112 pedals.

How many bicycles and how many tricycles did her mother have in her shop?



Mariela is standing in a building and looking out of a window at a tree. The tree is 20 feet away from Mariela. Mariela's line of sight to the top of the tree creates a 42° angle of elevation, and her line of sight to the base of the tree creates a 31° angle of depression.



Present students with just the question, and allow them opportunities to determine *how* they can go about solving the problem, and what information they would need to do so.

The focus is on the process, *not* on the answer.

What is the height, in feet, of the tree?

Teacher Dialogue

"What is the question asking?"

"Go ahead and answer the question"

*"**How** could you conclusively determine the height of the tree? What could you **do**?"*

"What information would you like to have?"

Purpose

Clarification to ensure students know what is being asked of them.

Allows students to try to answer the question and determine on their own that they need more information.

Prompts students to develop and justify their **process**.

Requires students to determine what they need and provide a rationale for why it is needed.

Benefits of presenting problems where focus is on student reasoning:

- Generates mathematical discussion among students.
- Students themselves determine *what is needed* (pieces of information) to answer the question, and *how* (steps and mathematical operations needed) to answer the question.
- The teacher *guides* students but does not explicitly show them how the problem is done (productive struggle).
- Students have opportunity to employ (and thus become more comfortable with) different problem-solving strategies.

What is the problem asking?

How would I figure this out? (my method)

workspace / draw space

What information do I need to know?

M1.5

How can I get the information I don't have?

What is the problem asking?

How would I figure this out? (my method)

workspace / draw space

What information do I need to know?

M1.6

How can I get the information I don't have?

Planning guide for: _____

Evaluate	Troubleshoot	Support
What skills and content knowledge do students need to <i>understand</i> the task?	Misunderstandings	How will students acquire and demonstrate understanding of the task?
Ways students may approach this task (method/steps)	Student Misconceptions	Guiding questions to <i>support</i> students
What information will students need to obtain?	What information might students ask for? What issues might they have with the information they find?	How will students be able to acquire the information they do not have?
What skills and content knowledge do students need to <i>complete</i> the task?	What struggles might students experience? At what points in the task will students need assistance or explicit guidance?	What supports will be in place to help struggling students? How will skills, concepts, and/or processes be conveyed to students?