NC COLLABORATIVE FOR MATHEMATICS LEARNING

NC²ML PRACTICE BRIEF

THE ROLE OF MATHEMATICAL TASKS (Grades 3-5)

WHY DO THE TASKS WE CHOOSE MATTER?

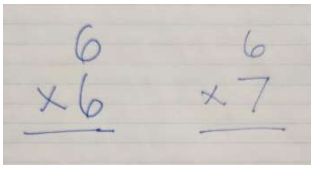
The mathematical tasks you pose during class determine the nature of the mathematics your students will engage in (NCTM, 2014). Selecting "good" tasks is not a trivial act, it greatly impacts your students' learning and their development of mathematical habits of mind. Tasks that require students to memorize a formula or practice a particular skill leads to a different type of learning than tasks that require students to consider multiple solution strategies and convince others that their strategies are valid.

Questions for Discussion

1. *In what ways might using low floor - high ceiling – wide wall tasks create a more equitable mathematics learning environment?*
2. *What are the instructional challenges you face when you use higher cognitive demand tasks? How might you mitigate those challenges?*
3. *How do you determine what tools you might make available to your students to help create a "wide wall" environment for a particular task?*

WHAT IS A "GOOD" MATH TASK?

The different types of thinking required of students to respond to a task is referred to as *cognitive demand*. Stein and Smith (1998) developed a framework for characterizing the cognitive demand of a task. This framework can be very helpful when selecting or revising tasks to meet your learning goals. In the framework there are two types of high cognitive demand tasks: *procedures with connections* and *doing mathematics*. Generally, high cognitive demand tasks are non-routine, requiring students to think conceptually about mathematical ideas. In contrast, low cognitive demand tasks require students to remember facts and procedures and apply them to familiar situations. There are two types of low cognitive demand tasks in the framework: *memorization* and *procedures without connections.* Brief examples of each type of task are provided in the figure below.

Low cognitive demand tasks	High cognitive demand tasks
Memorization Example. Copy these facts on your index cards. Practice saying the answer to each fact.  	***Procedures with connections*** Example. Sonya has 6 bags of pencils. There are 6 pencils in each bag. How many pencils does Susan have? Show your work using a picture and an equation. Write a sentence about how your equation matches your picture.
Procedures without connections Example: Sonya has 6 bags of pencils. There are 6 pencils in each bag. How many pencils does Sonya have?	***Doing mathematics*** Example. Sonya is putting pencils into goodie bags. She has 36 pencils. Each bag needs to have the same number of pencils, and she does not want any leftovers. How many pencils could be in each bag? Find all the possible solutions. For each solution draw a picture and write an equation to show your thinking.

PROVIDING "LOW FLOOR – HIGH CEILING – WIDE WALL" OPPORTUNITIES

While all types of tasks have a place in elementary mathematics classrooms, there is a need for teachers to carefully select and pose high cognitive demanding tasks to develop students' dispositions related to problem solving and reasoning (NCTM, 2014). Multiple research studies have found that using tasks with high cognitive demand are successful in improving students' conceptual understanding of important mathematics, in improving students' abilities to reason, communicate, problem-solving and make mathematical connections, and improving their performance on state and national achievement tests (Boston & Wolf, 2006). So, not only is it important for students that we incorporate more high cognitive demand tasks, but also that we identify "good" ones. Really "good" mathematical tasks are those that have entry points for every student in your class and allow space for extensions to keep all students mathematically engaged. We often use the phrase "low floor, high ceiling, and wide walls" to describe such tasks. (Low floor = anyone can access the task; high ceiling = there are lots of possibilities for taking things even further; wide walls = space to explore multiple pathways).

ENACTING A HIGH-LEVEL TASK IN THE CLASSROOM

Once you have selected a high-level task to use, take care to implement the task in a way that maintains the cognitive demand throughout the lesson. The launch-explore-discuss lesson format offers a structure to support students' engagement with cognitively demanding tasks. Launching a task in a way that provides support for students to unpack the meaning of the task while maintaining challenging is important. Further, students need independent and collaborative time to explore tasks without teachers' leading them to specific strategies. Teachers should provide and encourage the use of resources (e.g. manipulatives) for learners to represent their thinking as well as use questioning to scaffold and support students' exploration of tasks. Finally, teachers should carefully select and sequence the sharing of student solutions to foster discussion of the mathematics learning goal (Smith & Stein, 2018). *For additional information, see the following briefs on the NC²ML website: Launching a Task: Providing Opportunities for All Students to Learn.*

FINDING AND MODIFYING TASKS

While there are many low floor, high ceiling, wide wall tasks available in existing resources (e.g., www.Tools4NCTeachers.com), they are not always easy to find. As a result, students are often presented with low cognitive demand tasks even when they do not match the learning goals for the lesson. However, many tasks can be easily adapted. By providing less direction before a task is explored, and by asking broader questions a task can be transformed into a low floor, high ceiling, wide walls type task. When considering how you might adapt a task it is important to consider its intended purpose. Do you plan to use the task to introduce a new mathematical idea? To apply or practice a mathematical concept? Or for assessment of some kind? Identifying the purpose of the task will help you make decisions about adaptation.

For those of you who have curriculum and resources provided by your school district or school, one recommended practice is to spend time with your planning team or Professional Learning Community to examine tasks and consider ways to increase tasks' cognitive demand. For example, notice the examples in the figure on page one. The cognitive demand of the *procedures without connections* task was adapted to increase the level of demand by asking students to connect their work with manipulatives, pictures, or numbers with an explanation about how they solved the task. Additionally, the task was made even more open-ended by having students explore different configurations of distributing pencils into bags with a total of 36 pencils and assuming no leftovers. Teachers should have intentional time during planning to examine resources and consider ways to maintain or increase the cognitive demand of the tasks.

FINAL THOUGHTS

It is important to note that using high cognitive demand tasks takes careful planning. Beyond selecting tasks that are appropriate for the mathematical goals of your lesson, you must also carefully consider both how you will support students' work on the task and how you will facilitate a discussion after exploration that is focused on your learning goals. Smith and colleagues (2008) have a useful planning protocol to help you plan lessons.

REFERENCES

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