Meaningful Math For All Students
by Casey Karger

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Meaningful Math for Low-Level Students

When tasked with creating a complex and meaningful math problem, I thought about how my students are different from the students of some of my colleagues. My students tend to be at the beginning of their educational journey. They are definitely hard workers, but they are likely to be lower-level students. My colleagues, however, often have high-performing students: students who are at the end of their educational journeys—about to take that last step and earn their HSE diploma. So, I wondered, "How do I design a valuable and engaging problem that teachers can use with students at all levels?"

The Mural Problem

The idea of low-floor/high-ceiling math activities is not a new idea nor is this the first or best example of one. In an effort to explain why I chose this problem, I thought that I would walk you through what struck me about this problem, why I chose it, and what I learned from doing this with a few classes.

Many of us are instructors placed squarely in the middle of a one-room schoolhouse, a classroom with students at all different ability levels. These classrooms are notoriously difficult to manage and teach because the whole classroom requires differentiation. Even in this environment, there are advantages in whole group instruction! It's beneficial when students learn from one another and teach one another. It's not easy, but it is valuable. So, how can we design problems, lessons and units that fit, mold, and serve our students?
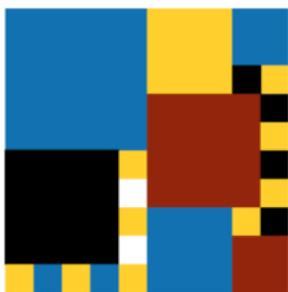
First, we must find problems that are appealing to our students. For this problem, I found an image. I am on the mailing list for youcubed.org and received this newsletter from Jo Boaler with this image, along with the question, "What kind of math questions can we ask from an image like this?" For my students, having a model that is visually appealing can be crucial to engagement. The minute that this picture went up on the board, conversation erupted. These kinds of reactions and images are rare, so it's up to us to save and use them whenever we can.

Second, in order for these types of problems to be successful in whole-group instruction, there has to be some complexity in the questions generated from them. I chose to make this question about a mural and to

focus the task around the concept of area. The question I asked is this: "How many square feet of each color will Jay need to complete their mural?" This type of question created some context for how the students may engage with the image.

What My Students Did

What I love about this image is that it can enable those students with a more advanced conception of area to jump right into calculations. What my students did, however, was to grab rulers and graph paper, draw shapes, and count the number of squares. Both of these strategies reinforce what I hoped my students would learn about area. It developed the concept of how many units it will take to fill a two-dimensional polygon (in this particular example, a square.) It created a problem that all students could work on independently, talk about with other students, and compare and contrast different ways to solve this problem. What I loved most about this problem is how well it supported students. I designed this problem with my students in mind, so I wanted to make sure that it was accessible to students at low levels of math. However, I recognized very quickly that, with a few tweaks, I could expand the problem to be more challenging for higher-level students.

Push and Support Cards

In conversation with Mark Trushkowsky, he introduced me to the idea of push and support cards. These cards, when used correctly, become an invaluable tool for differentiation and for creating a classroom environment that can be run by one instructor in a one-room schoolhouse. These small cards contain hints, extensions, tips, and more to help students engage with the problem. For lower-level students, support cards ask questions like: "How do the white squares compare to the squares around them?" and "How does the big blue square compare to the entire image?" These questions can help to guide student thinking in a way that gives them valuable information without giving them a procedure to follow or an answer. It forces them out of their mental ruts and back onto the track of solving the problem. For our higher-level students, push cards became essential in keeping them engaged and pushing their understanding. When a student finishes working through a problem, instead of their immediately turning to "help" a friend, potentially ending the process of productive struggle that the friend may have been engaged in, we've created small extensions like, "How does the solution to the problem change if the mural is 400 square feet?" and "If each of the tiles cost x dollars, how much will the materials of the mural cost?" This allows the more experienced students to deepen their understanding and be challenged while the instructor still has the ability to support those students who need more help.

Meaningful Math For All Students

Low-floor and high-ceiling problems are nothing new in math classes across the countries and across grade levels. With some of the tips we've discussed here, I hope that you'll see the value of these types of activities and work to incorporate some into your classrooms. Whole-group instruction, while challenging, is valuable. We just need creative and thoughtful approaches about how we can teach students at all levels the same, accessible, and challenging material.

Go to CollectEdNY to access Push and Support cards and examples of student work for The Mural Problem.

The Mural Problem
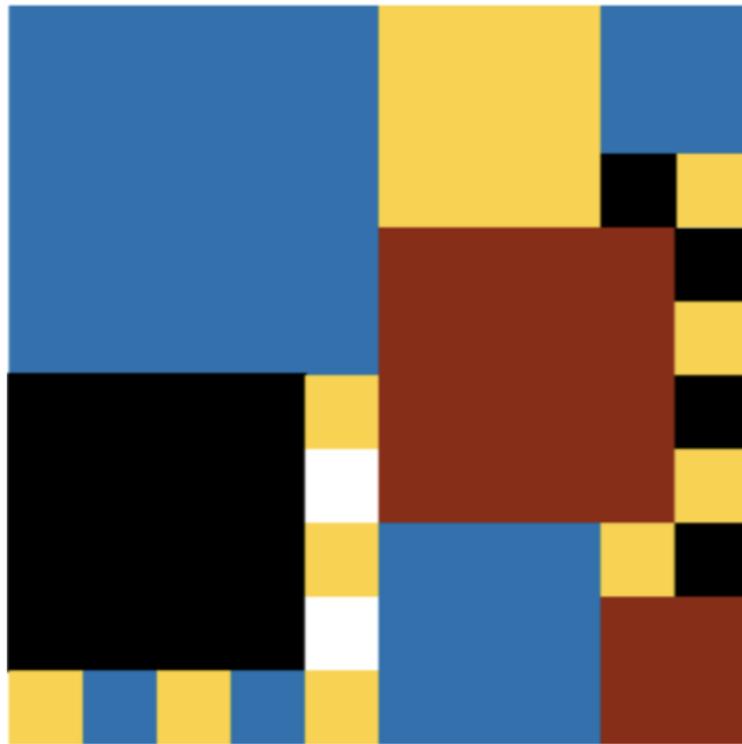

What do you notice?	What do you wonder?

The Mural Problem
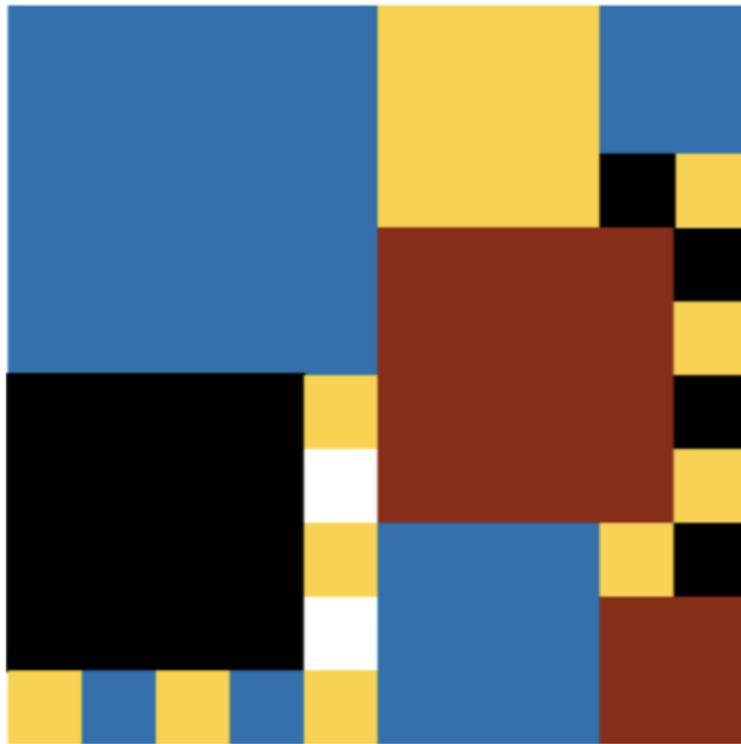
Jay is an artist who makes abstract tile murals like the one seen here. They use square tiles of different sizes to make murals in and on buildings in the city. Jay has been asked to create a mural for a 100 square foot space in the lobby of the City Art Museum and has created a design that incorporates 5 different colors.

How many square feet of each color will Jay need to complete the mural?