MOTIVATED

Ilana Seidel Horn

Designing **Math Classrooms** Where Students Want to **Join In**

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This book is dedicated to

Peg Cagle, Rafranz Davis, Sadie Estrella,
Chris Luzniak, Fawn Nguyen, Elizabeth Statmore,
and all of the dedicated mathematics
teachers who show me what is possible with their
intelligence, insight, imagination, and love.

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1 | The Motivational Classroom

It is the second week of school. Students file into Ms. Gudinoff's eighth-grade classroom, some talking loudly with their friends as they settle in, a few sidling in quietly and sinking low in their seats. Ms. Gudinoff is at the front of the room, sorting papers and organizing her lesson materials. She feels a little nervous today. She is going to try something new: to engage students' mathematical thinking with a rich problem. She learned about leading mathematical discussions at last weekend's professional development workshop, part of her district's initiative to support deeper mathematical learning. After the bell rings, Ms. Gudinoff projects the following task on her SMART Board.

Directions: The larger figure below is a square. It has been partitioned into pieces. Each piece is identified with a letter.

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> *"OK, we're going to try something new here," she announces. "I'd like you to get out a pencil and paper and spend five minutes quietly thinking about how you would find what fraction A is in this picture. Work by yourself first, then we can share our ideas." She colors in rectangle A on the SMART Board and writes, "What fraction of the square is A?" saying aloud, "OK, everybody got it?" She scans her class, sees a few nods, and hears a smattering of yeahs. After the students get out their materials, the next five minutes pass in relative silence, the sibilant undercurrent of whispering voices punctuated by scratching sounds of pencils on paper. As she watches her class at work, Ms. Gudinoff notices the following: a pair of girls, Mia and Riley, with their heads bent together over the problem; a handful of doodlers; one napper; several furrowed brows, with heads cradled in their hands; and many students stopping and starting as they make marks on their papers. She calls the class back together, saying, "OK, who wants to tell me how they started?" Looking around the room, the children appear frozen. She counts the seconds off in her head, remembering the importance of wait time. When she gets to fifteen, the silence starts to feel like a standoff: Who will break it first? It is Ms. Gudinoff. "Anyone have any ideas?" she tries again. Nothing. "Mia and Riley, I saw you discussing something. Can you share with the class?" The girls look mortified, as if she had asked them to do a chicken dance in front of their peers. Ms. Gudinoff sees a ripple of scowls and eye rolls pass across other students' faces, and Zachary mutters, "Not them again!"*

Ms. Gudinoff had a lot going for her in this scenario. She had a rich problem with something discussable that had the potential to surface important ideas about fractions. She helped students focus on a reasonably small—but very doable—part to get them started, checking in to make sure they understood the task. She gave them a sensible amount of time to think quietly, giving some latitude to Mia and Riley, whom she knew gained confidence in discussing their ideas together. When her students seemed reluctant to share, she used the tried-and-true wait time strategy.

Nonetheless, when she called the class together to orchestrate a discussion, the students balked. Some students seemed to struggle to figure out what was being asked of them. Others were simply horrified of having their thinking on display in front of their peers. In any case, the mathematical discussion she was hoping to seed through this rich problem had no chance to take root. The ground of her classroom, it seems, was infertile for such activity.

Social Risk

What does it take to create classroom climates that support and sustain mathematical conversations? To answer this question, we need to survey the landscape and identify what is making the environment inhospitable. We notice immediately that we are among a group of self-conscious adolescents. Indeed, students often avoid participating in mathematical discussions because publicly sharing their thinking is a *socially risky endeavor.* Social risk means *threats to one's status in a community*. Young people often come to school uncertain of their standing with their peers and teachers. At the same time, they are often highly preoccupied with their status. They tend toward activities that will be status enhancing—or at least, status preserving. They avoid activities that are status threatening, endangering their status in the eyes of their peers.

In planning her lesson, Ms. Gudinoff thought a lot about the mathematics of the task. She considered the different ideas students would have and how she would respond to them. She even took the time to give them a toehold into the problem, allowing five minutes of private think time before she asked them to share their ideas. What she did not account for was students' experience of being in her class: their sense of belonging, what this activity meant to them in their lives, their concerns about looking smart or dumb in front of their peers. These are the central issues of social risk.

Typical math lessons can proceed without accounting for social risk because they rely primarily on *known-answer* questions. Known-answer questions are less risky because students have models or prior examples to draw on when they respond. If a class has spent a week talking about linear equations, many students do not find risk in answering:

What is the slope in $y = 4x - 2$?

This known-answer question only requires students to remember the slope-intercept form of $y = mx + b$ and successfully match the slope (m) to the 4. There might even be a cue in a student's homework or notes that lets the student answer without understanding.

However, the social risk increases when a teacher asks:

What do you think will happen to the graph if I change the slope to -4? Explain your reasoning.

This second question requires students to *predict, make connections* between equations and graphs, and *justify their reasoning*. Students cannot easily draw cues without understanding. They must grasp underlying ideas about positive and negative slopes. Although these practices are an important part of mathematical thinking, they are difficult to elicit in mathematics classrooms because of the social risk involved.

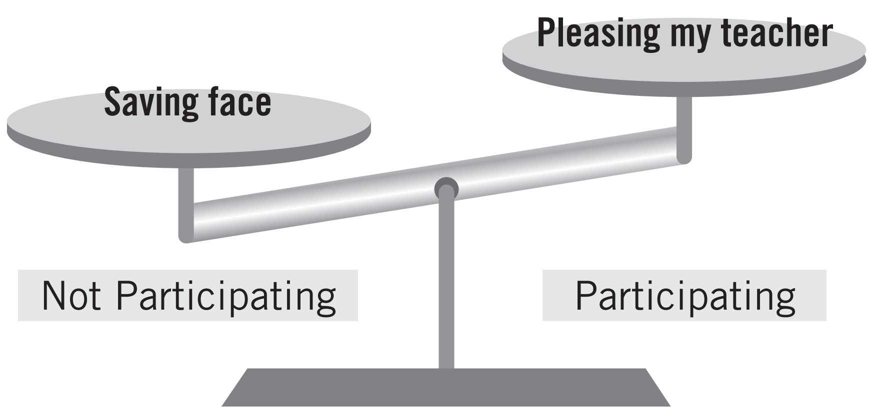
Social risk also depends on students' relationships to their peers. In the opening vignette, Mia and Riley may have had some confidence in their approach, but Zachary's muttering shows some of their peers' resentment for their level of investment. Even when students have ideas, they may be reluctant to share them because of the risk posed to their social status.

Mathematics Classrooms as Socially Risky Places

Although social risk is felt in many classrooms, mathematics classrooms are particularly burdened with social risk. Mathematics, as a school subject, is culturally anointed as the ultimate measure of smartness. The logic goes: If you are good at math, you are truly smart. If you are not good at math, you are not truly smart. Many of us, as mathematics educators, have encountered competent adults who confess their insecurity over not being "good at math." Because of the linking of mathematics and "true" smartness, when students share their thinking in the public space of the classroom, they often perceive risks to their academic status that go beyond the immediate content, extending instead to their overall intelligence.

Adolescence as a Socially Risky Time

Adolescents have two things going on that heighten the risk of sharing their thinking. First, they have years of history with math class as an evaluative environment that hampers them from sharing their ideas—especially when they are only partially formed—out of fear of looking foolish or dumb in front of their peers. Exacerbating this, adolescent students are increasingly aware of and dependent on their peers' approval, especially compared with their time in the primary grades. This leads to particular challenges for secondary teachers who want to elicit students' ideas. When students compare participation's risks (e.g., losing face in front of their peers) to its perceived benefits (e.g., pleasing a teacher), they often calculate that it is not worth doing.



This poses a conundrum for mathematics teachers who want to teach ambitiously. Meaningful mathematical learning, which is the goal of ambitious instruction, involves exploration, false starts, and confusion on the way to deeper understanding. How are teachers to persuade students to engage in such socially risky activities at a time in their development where they are least likely to want to participate in them?

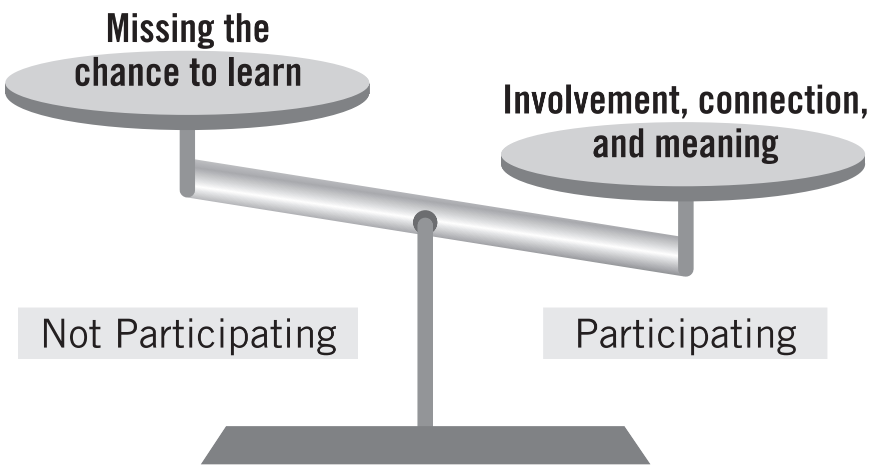
Designing Motivating Instruction

The answer offered here lies in instructional design. By *design*, I am not referring to a prescribed set of routines, activities, or seating arrangements. Instead, I offer a framework for thinking through teaching choices in ways that attend to motivational issues and support students' participation. Motivation, in this context, goes beyond the everyday sense of the word, which usually means getting students excited or interested in mathematics by couching problems in contexts that appeal to their adolescent sensibilities like pop culture, sports, fashion, or music. Instead, the motivational framework I describe attends to the social and emotional conditions that students need to participate effectively in mathematical activities.

Designing to motivate is a familiar practice to many people. For instance, we may all "know" that it is healthier to satisfy a sweet tooth with an apple than with ice cream, but faced with both foods as a snack option, we do not always make the healthiest choice. (This may or may not be an autobiographical example.) Knowing our own weaknesses, we can design our environments to make fruit more readily available than sweets. My favorite example of motivationally oriented design comes from Odenplan subway station in Stockholm, Sweden. To encourage more people to take the stairs instead of the escalator at the subway passage, a group called FunTheory.com covered the stairs with piano keys. (If you have seen the movie *Big*, you can picture the giant piano that resulted. Or just search for "subway piano stairs" on YouTube.) With the new design, 66 percent more people took the stairs than the escalator, simply because it was motivating to have the chance to play instead of a drag to take the stairs. Putting up signs about the health benefits of stairs fails to motivate a typical commuter, just as seeing the nutrition label on an ice cream container does not always motivate me to eat an apple. This is the goal of motivationally oriented design: helping people to engage in beneficial behaviors not by merely informing them of their value but also by making them easy and desirable.

For teachers to motivate social risk taking, they must look at the classroom environment and find ways to change the risk-taking calculus. By putting piano keys on the stairs, the designers shifted *taking the stairs* from an objectively better but actually less appealing choice to the amusing and desirable choice. The stairs were no longer the *harder* option but instead became the *fun* option. This kind of design thinking changes people's cost-benefit calculus: the cost of taking the stairs is far outweighed by the benefit of playing the piano while walking on them.

In a similar way, we, as teachers, need to design instruction and classroom spaces that lower the risks and raise the benefits of participation. To lower the risks, for instance, we need to work against students' assumptions about mathematical smartness and make socially safe spaces for students to be wrong without losing face in front of their peers. To increase the benefits, we need to design instruction where students feel *invited*—even compelled!—to share their thinking. In fact, in truly motivational classrooms, *not* taking risks—withholding thinking—becomes a less attractive option for students and their learning, just as the escalator became a less attractive option than the piano stairs.



To develop this motivational framework, I draw on the work of psychologists who study the social and relational aspects of motivation, translating these theoretical ideas into principles for instructional design. The work of psychologist Julianne Turner and her colleagues (2014) provides a great starting point. They spent three years collaborating with middle school teachers around central ideas about motivation to support deeper learning and shift students' social risk calculus. Their work with teachers focused on applying four motivational constructs to instructional design: belongingness, meaningfulness, competence, and autonomy. Over many decades of research, social psychology has linked these constructs to motivation. Because teachers work in classrooms and need ways to engineer student behavior, I add a fifth construct—accountability—that provides the feedback mechanisms that help shape students' participation. In the chapters ahead, I illustrate each of these five constructs with examples from the featured teachers' classrooms. Because these constructs need to work together in any teacher's practice, I offer an overview of the framework here to help readers envision how they might work in concert to create mathematics classrooms that reflect motivational instructional design.

Features of a Motivational Classroom

A motivational classroom attends to the following five features:

- students' sense of *belongingness*
- the *meaningfulness* of learning
- students' *competence*
- structures for *accountability*
- students' *autonomy.*

Teachers can foster all of these through deliberate instructional design as they tinker to motivate their students.

Belongingness refers to people's innate need to establish close relationships with others. In the opening vignette, the students who slinked down into their desks, doing everything physically possible to make themselves disappear, communicated with their body language that they did not feel like they belong. In contrast, when students experience frequent, pleasant interactions with others or feel that those around them are concerned for their well-being, they feel like they belong. Although Ms. Gudinoff's classroom climate would benefit from numerous adjustments, something as simple as a warm greeting as students enter the door might go a long way toward helping the reluctant ones trust that they belong there. This, in turn, can pay dividends in participation. Research has linked students' sense of relatedness and belonging to social and academic engagement (Stipek et al. 1998; Furrer and Skinner 2003). In general, teachers can foster a sense of belongingness by encouraging and modeling an environment of mutual respect. In our vignette, this might include addressing Zachary and other students' disdain for Mia and Riley's enthusiasm.

Meaningfulness involves developing an interest in or appreciation for academic content. Every math teacher gets asked the same question at one point or another: When are we ever going to use this? Instead of viewing this question as students' resistance or reluctance to learn, we should understand that they are often searching for meaningfulness. When students experience their learning as connected to their own lives or questions, it raises engagement and achievement (Wigfield and Eccles 2007). Teachers can cultivate meaningful learning by building on students' prior knowledge and experiences, providing access to complex ideas and extended exploration. Perhaps Ms. Gudinoff could have related the fractions question to children's persistent concerns about sharing. Teachers can also model meaningfulness by emphasizing their own interest in and the value they place on what they are teaching.

Competence describes the need to be successful in meeting goals and interacting with the environment (Wigfield and Eccles 2007). By the time students arrive in our classrooms, they have often had many experiences feeling *in*competent in mathematics. This comes from countless sources: they have not been able to succeed on the "mad minute" fact tests, a state assessment has labeled them as "basic" in their mathematical proficiency, or family members or other teachers have let them know that "some people are just not math people." Because school math commonly values two primary forms of mathematical competence—quickness and accuracy—students have seldom had a chance to recognize their own mathematical strengths. Teachers can increase students' sense of competence by providing appropriately challenging tasks, giving formative feedback, and helping students recognize their own mathematical strengths. Teachers can also increase students' sense of competence by normalizing mistakes as opportunities to grow and learn. This fosters effort and persistence.

Accountability refers to the structures and routines that oblige students to report, explain, or justify their activities. Often reduced simply to *assessment*, accountability goes beyond how we grade to encompass the routines and norms that enjoin students to participate in particular ways in classroom life. When students feel a sense of investment in and accountability to their classmates, for example, this changes the risk-benefit calculus, leveraging positive peer pressure to increase participation. Likewise, if students have some say in their activities or understand the relationship between those activities and their personal goals, they will have a greater sense of commitment to seeing them through (Fielding 2001). Research has shown that accountability systems that provide ongoing feedback for learning help close achievement disparities and support students in developing self-regulation of their own learning (Stiggins and Chappuis 2005).

Autonomy is the need to behave according to one's interests and values. The opposite of autonomy is dependence; most math teachers have encountered students who ask for help at every step of a problem, because they have not yet developed their own resources for making sense of their work and seeing it through. Autonomy can be seen in the classroom when students pursue their own curiosities, work to organize their schoolwork, and contribute to the classroom community. Research has linked autonomy to numerous positive outcomes, including staying in school, deeper conceptual learning, seeking intellectual challenge, and enjoying academic work (Turner et al. 2014). Teachers can inculcate student autonomy by linking instruction to students' strengths and interests, giving meaningful reasons for learning different content, allowing students the time they need to learn, and valuing different ways of thinking about ideas.

Connecting the Motivational Features

There are many connections across these five motivational features.

For example, *belongingness* and *meaningfulness* are mutually reinforcing, because *belongingness* implies that students' own interests and curiosity have found a place in the classroom. This provides fodder for an alert teacher to build meaningful mathematical activities. Likewise, *accountability* and *autonomy* are connected. If classrooms are designed in ways that press students to feel *accountable* to one another's learning, this will foster *autonomy*, as students develop ways to function using their own resources and not solely rely on teachers, textbooks, or the "smarter" students. *Competence* contributes to a sense of mathematical legitimacy and thereby increases students' sense of belongingness. These are just a few examples. Others will be explored in the pages ahead.