Motivation Matters and Interest Counts

Fostering Engagement in Mathematics

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NATIONAL COUNCIL OF
TEACHERS OF MATHEMATICS
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All Students Are Motivated: Why It Matters to Understand the Reasons Students Do What They Do

This chapter begins with a story about a middle school student named Grace. Her story illustrates that students are neither motivated nor unmotivated; they are both. Under certain conditions, a student may behave one way, but she may behave differently in another situation. A student’s engagement can be seen to be a function of the classroom organization and social setting as much as her own beliefs about her abilities and about mathematics.

After Grace’s story, we will discuss the purposes and goals of this book. We begin each chapter in this book similarly to this chapter – with a story that illustrates either one of six principles of students’ motivation or one of five research-based categories of teaching practices that can motivate students. Through Grace’s story, we explore facets of three of the six principles of students’ motivation: motivation is adaptive, motivation is social, and success matters. We examine Grace’s story through these principles to illustrate how the principles can be used as lenses to think about students’ motivation, and we entertain instructional dilemmas present in Grace’s story to think about implications for teaching practice.

A Typical Day in Grace’s Mathematics Class
(Adapted from the Master’s Thesis of Kateryna Ellis)

Today in third-period prealgebra, Grace wasn’t really anxious, but she wasn’t excited to be there, either. If you talked to her and asked her to describe herself as a mathematics learner, she would say that she was fourteen years old, outgoing, willing to try hard or challenging math problems, and liked to explain her answers. Grace also would say that she liked to work with numbers and liked to learn more about math. When she was most open and honest, she would tell you that solving a
difficult math problem not only helped her learn, but it helped her show other people that she was smart, which mattered to her. She would share that she would always try every problem on her math homework and would offer to participate during discussions in math class. However, she also would acknowledge that she would get in a rush sometimes. She was sometimes inattentive when reading problems, and sometimes this carelessness led her to solve problems incorrectly. Mr. Lawson, her mathematics teacher, never admonished her for being incorrect, but sometimes she was embarrassed when she was asked to explain her reasoning when she was wrong.

Mr. Lawson thought that Grace was quite smart. She frequently showed sophisticated methods when solving problems. She talked about how she planned to go to college, and these future goals seemed to motivate her to try to be successful in mathematics class. Grace’s motivation showed especially when the material was of great interest to her or when she was learning something she felt strongly about, like the environment. Mr. Lawson noted that if he could get Grace curious about something, she would put out effort and work hard to learn.

Grace’s eighth-grade prealgebra class consisted of students in an accelerated track, fairly evenly divided between boys and girls. Earlier in the year, Mr. Lawson had established clear norms for participation; students appeared to understand that anyone could be called on to justify any answer at any time during the period. Mr. Lawson did not give students a lot of time to work in their small groups, and he encouraged class members to help one another. There was no penalty for not understanding—if you could not get a handle on the problem, the teacher would stop by and give you some assistance. The students could be seen gazing around the room, writing, or looking at the book in front of them. Some students talked to one another, some called out to the teacher, and some sat silently at their tables waiting for someone to give them the answer.

Although the atmosphere within tables was of cooperation, the feeling among tables was definitely of competition. Students would rush to be the first to solve any given problem and loudly proclaim to be “the smartest kids in the class!” This need for social recognition was a hallmark of this high-ability class. Students believed that being in an accelerated class separated them from the other students in the school, and they tried to find ways to win recognition both from their teacher and their peers.

Grace usually sat at a table with Nacho, Adam, and Janey. On this particular afternoon, Grace came into class as she usually did, talking with Nadia and Jenn. She split from her two friends to join Nacho and Adam at their table. Janey arrived just before the bell rang, puffing because she had to run all the way across campus from the gym.

“Jeez, Janey, you are sweating like a pig!” Adam commented.

“Oh you love it!” said Janey, putting Adam in a sweaty headlock. “Weee! Weee!”

“Ahem,” coughed Mr. Lawson. “I have heard that pigs are quite intelligent. It doesn’t seem as if you are of that family, given that you are on the verge of detention.”
The group eyed each other, laughing, but calmed down and tried to pay attention. Mr. Lawson continued, “I think I am going to have to split you up. Janey and Grace, come over here and sit with Monica and Marisol. Adam, you and Nacho sit with Carlos and Terrell. Okay? Here we go.” He proceeded to hand out a worksheet with the following problem.

A group of students want to share a cake shaped like a cube. (This is a mathematical cake: It is frosted on all six sides). They want to cut it into portions of 1-unit cubes. Each student receives one small portion. Being smart students, they notice rather quickly that the number of people who have no sides frosted is exactly 8 times the number of people who have pieces with three sides frosted. How many students got a piece of cake?

Each of the girls in her group, including Grace, first tried to solve the problem separately. They knew that their teacher expected them to try the problem on their own before discussing the problem with their peers. Individually, the girls took notes and wrote down their thoughts. After they each made some progress on the problem, Grace and her new tablemates shared their ideas with each other in quiet conversations.

“I drew a picture of the cube. I saw that the 8 corners had 3 sides frosted, so the total number of unfrosted pieces is 8 times 8 equals 64. From my picture, the middle cube has to have 64 little pieces, so I thought what times itself 3 times is 64?” Marisol offered. “So that has to be 4 times 4 times 4. So I drew in 4 by 4 in my picture. Then I saw it had to be two more on each side so the whole cube had to be 6 by 6 by 6 equals 216 cubes.”

Grace said that she did a similar drawing (see fig. 1.1) but then said, “I saw the 4 by 4 by 4, but then I saw two sides which were 6 by 6, and another two sides that were 6 by 4. So 4 times 4 times 4 equals 64, plus 2 times 36 equals 72, plus four 24s equals 96. 64 plus 72 plus 96 equals 216.”

“No it doesn’t! That equals 232.”

“You can’t both be right if your answers are different,” broke in Mr. Lawson. “Can you prove your answer?”

Argument ensued, with Grace defending her point and Marisol countering. Eventually they discovered a small mistake in Grace’s counting. The surface of the cube had to have 2 sides of 6 by 6, 2 sides of 6 by 4, and 2 sides of 4 by 4; otherwise some of the cubes were double-counted.

All three girls participated in solving the problem and had been involved in active teamwork discussions. When they worked on these problems, the girls first used their own individual strategies and solutions to find the answer. Only then did the group look over the proposed strategies and choose the correct answer. This practice encouraged the girls to discuss the answers that they had found and the methods by which they generated them. These conversations and discussions
were expected to increase the likelihood that girls would detect and correct one another's errors. Once errors were detected, students made attempts to remediate those errors for themselves, with a little prodding by the teacher. This group of girls showed a strong, positive dynamic among themselves in cooperative learning and understanding mathematics.

During the whole-class discussion after group work, Mr. Lawson asked Grace to explain her reasoning. She gave her answer and explained the steps she used to solve it. She spoke in a clear voice that expressed confidence in her reasoning. Grace's choice of strategy and her solution were logical, building on her understanding of volume and surface area.

Following this portion of the lesson, Mr. Lawson moved Grace from the homogeneous group of girls to a newly formed, heterogeneous group, because he hoped that Grace's enthusiasm would catch on with the members of her new group to involve themselves and discuss their thinking with one another more thoroughly. This class, like many middle and high school classes, had a variety of behavior issues related to personality clashes, friendship groups, and random mood swings among its members. Mr. Lawson often switched membership in groups, attempting to obtain better overall classroom behavior. But Mr. Lawson did not share that rationale with Grace. She was the only girl in her new group, mixed with three boys. Grace was not excited about the change in the seating arrangement. She walked slowly from her desk to the new group and made a couple of comments to her earlier group of girls and the teacher that she would prefer to stay at her desk. Once new mathematics tasks were presented to the class, Grace's behavior changed dramatically, as if she perceived the move as a punishment. Grace seemed to lose her interest in the
mathematics problem. In her new group, students did not interact with one another and did not participate in an open discussion. Nevertheless, each of them did write some examples in their notebooks. When some of the students in the group did not understand a given question, they did not try to ask their teammates for help. They did not share their thinking; they simply tried to match their answers to the correct ones. During the rest of the class period, Grace sat quietly behind her desk and withdrew herself from participation. Rather than positively influencing the quality of participation in her new group, she adopted their approach of keeping to themselves. Grace twice tried to interact with her earlier group of girls instead, but the distance between tables made it impossible for her to do so effectively. As soon as the bell chimed to signal the end of the class period, Grace jumped and rushed toward her original group, where the girls were discussing the whole “relocation” deal.

Principles of Students’ Motivation in Mathematics Classrooms

Teaching mathematics is a wonderful job, but it is a tough job. Children come to us with a variety of abilities and interests, reflecting a myriad of cultures and values. These individual characteristics are so varied that no two children are exactly alike, so much so that the strategies we devise to support one student often fail when applied to another.

From your time as a student, perhaps you can remember a day like the one Grace experienced, one where you have conflicting emotions, conflicting goals, definite opinions about the role of mathematics in your life, and definite opinions about your role in the mathematics class. Sometimes life seemed to conspire to make you grumpy, even in a class where you had friends, where the teacher assigned challenging problems and was careful to listen and support your learning.

Of course the goals, abilities, and opinions of teachers and students need to work together somehow for a productive learning environment to exist. This book addresses this issue. We are intent on helping teachers reflect on the goals they have for instruction, matching them with the knowledge, beliefs, aspirations, and emotional needs students bring to the classroom. We then make instructional decisions that increase the probability that the student will buy into the argument that engaging in mathematics is important, useful, interesting, safe, and socially productive in a personal sense. In other words, we believe that teachers can begin to change their practice so that it builds students’ mathematical interest, self-interest, and self-confidence as an integral part of building their mathematical knowledge and skills.

Throughout this book, you will meet mathematics teachers and mathematics learners like Grace with her conflicting motivations, in stories. We believe that stories are an important tool for professional learning in that they present realistic people, in all their complexity, trying to do what is best, what is expedient, or what will help
them just get through a situation with their self-confidence intact. Stories show how a person’s behavior reflects both their internal beliefs and the environment within which they must negotiate life’s presses. Time plays a special role, helping us think strategically about how to affect students’ motivation, because events that appear earlier in a story relate causally to events that appear later. Mr. Lawson’s actions, along with those of Janey, Marisol, and the other classmates, together affected the decisions Grace made to engage in a rather substantial mathematical task on the one hand, and to disengage on the other. Grace’s decisions, therefore, can be seen as much a function of the classroom organization and social setting as of her own beliefs about her abilities and the role of mathematics. Through these stories, we can illustrate pivotal principles that reflect the best research on motivation as they play out in real classrooms with real teachers and real students.

Each chapter in this book will begin with such a story. After each story, we will discuss the salient features of motivation to learn mathematics through six essential principles. These six principles are general, drawn from the wide range of research on students’ motivation, self-regulation, social behavior, and learning, and we can thus adapt them to a wide range of academic subject matter. But research also shows that mathematics is a special case. The social benefits and stigma of being “good” or “poor” in mathematics, the role of success and failure, and the impact of societal attitudes and personal beliefs about the subject’s importance are more pronounced for mathematics. The resulting impact on future engagement in mathematics courses and mathematics-related occupations is therefore more dire than that of other subjects. These principles, then, make up what we know affects students’ feelings, engagement patterns, and long-term valuation of mathematics with reasonable certainty.

Briefly, the five principles of motivation to learn mathematics, and the chapters in this book to which they relate, are the following:

1. **Motivation is learned.** *(chapter 2)*. No inherent reason exists for mathematics to be considered any more difficult, confusing, or okay to perform poorly in than any other school subject. The fact that mathematics in general is viewed this way is a function of the learning environment where students grow up—the classroom, school, and home environments and the larger culture within which these institutions exist.

2. **Motivation is adaptive.** *(chapter 3)*. If, at its most basic level, we can define motivation as the reasons people have for behaving a certain way in a certain situation, then we can see that children are always trying to adapt meaningfully to the features of the environment in which they find themselves. Even maladaptive behaviors—such as not doing homework—can be useful to help us design productive learning environments, if we ask why the student chose to engage in the maladaptive behavior and to what personal goals this behavior appealed.
3. **Motivation is “in the moment”** *(chapter 4)*. We learn to be motivated by mathematics through engagement in tasks that pique our imagination, challenge our abilities, and afford us the opportunity to learn at an optimal level. Without such tasks and a classroom culture that supports engagement in them, a student likely will never have the opportunity to learn to recognize that mathematics can be interesting, that it can be useful, and that he or she can do it at a prodigious level.

4. **Motivation creates long-term attitudes** *(chapter 5)*. The evidence that people tend not to value mathematics in a personal sense is all around us. Proportionally, few students choose to take mathematics courses beyond minimum requirements in high school or college. Fewer still choose mathematically intensive careers. The statement “I’ve never been good at mathematics” is acceptable in social circles. People tend to have reasonably consistent experiences in school mathematics that continually reinforce that engaging in mathematics is a bad idea. Countermanding this general tendency is difficult; it requires that we work together as an educational system to change the way we talk and do business. What would your own attitudes be if you had had consistent, coherent, positive experiences in mathematics?

5. **Motivation is social** *(chapter 6)*. Human beings seek relatedness with one another. To be part of a group with common goals, ways of talking, and behaving gives us a sense of belonging. It is a natural focus of our interaction. When people around us are nervous, perhaps before a test, we tend to mimic their anxiety. When people around us are having fun—for example, examining relationships among data—we tend to enjoy the task. Motivation to learn mathematics, therefore, isn’t just a function of the child and his or her beliefs; we can see it as stemming from how people fit with their environment. Fitting in really matters, both intellectually and socially.

6. **Success matters** *(chapter 7)*. Success is motivating, and failure is off-putting, right? Well, it is not so simple. Think about it. If you succeed in a situation of trivial challenge, the success really isn’t very valuable. But if you succeed in a challenging task, that success bolsters your sense of competence, and you reap the good feelings associated with competence. Moreover, failure on challenging tasks, if it doesn’t happen all the time, is expected. That is one thing that makes a challenging task worthwhile: some chance exists that you might not get it right. When people attribute their successes to hard work and ability, they tend to become more motivated to learn. But also, other people seeing us as competent motivates us, and we will try to demonstrate our competence when others value it. This dance between internal attributions and external comparisons to others plays out continually in mathematics class.
Although each story could describe each of these principles and others, we will highlight and reflect on a story’s most salient principles, ones that have the best potential for intervention and support. In other words, we focus more on where a teacher has a good probability of successfully helping a child develop mathematical interest and positive dispositions than on where change is unlikely or impossible. After all, if you read this book and don’t take away any ideas that help you change your own practice positively, then we largely have not achieved our goals as authors. Below, we discuss these principles in more detail as they apply to Grace’s story.

**Show Me Somebody Who Is Unmotivated, and I Will Drive You to the Cemetery Where They Are Buried**

Before we jump in with both feet, we must acknowledge one overarching principle that guides our work as teachers, teacher educators, and researchers: All students are motivated! After all, if we think about motivation as a reason to do something (e.g., a wish, intention, or drive; Hulleman et al. [2008]), then everyone has a motive to engage in something. But students are not always motivated to learn and do mathematics. The corollary to this principle is simply stated: To be alive is to be motivated. This principle is important in that it places a burden on us as teachers to know our students. Like Grace, students will appear to be more or less motivated depending on the situation. For Grace, social interactions and interpersonal relationships affected her motivation to engage in the mathematics tasks assigned in Mr. Lawson’s class. Instead of being unmotivated, Grace chose to focus her motivation on different goals and values, actively pursuing them. Sometimes they aligned with her goals for mathematics learning, and sometimes they didn’t. In this story, Grace drew on the classroom’s social rules and her own need for relatedness to make decisions about how to engage in the assigned tasks. Her behavior illustrates important facets of three of our six principles: Motivation is adaptive, motivation is social, and success matters.

**Motivation Is Adaptive and Social**

Students will appear to be more or less motivated depending on the situation. Students are motivated to participate in discussions in the mathematics classroom partially to demonstrate their mathematical competence and attain status associated with appearing mathematically competent. Conversely, they sometimes disengage to mask their feelings of incompetence.

As we look at Grace, she appeared to be a very different mathematics learner depending on the students with which she was working. She interacted differently in her two different groups, and this affected her learning in each group. Grace appeared to be more motivated with Janey, Monica, and Marisol than she did with the boys. In the homogeneous group of girls, Grace and her peers each tried the mathematical
task, and they tried to understand one another’s solutions out of a need to resolve which solution was correct.

We can view the engagement in the group of girls through the perspective of students’ needs to seek relatedness while working on mathematics together with peers. When students work together on academic tasks, they are motivated not only to learn the content, but also to build and maintain relationships with their peers and to be recognized for what they know. In Grace’s group, when the students sought to determine whether Grace’s solution was correct, they may have been trying to resolve a social conflict—whose solution is correct—just as much as to resolve the mathematical conflict—which solution is correct. The students may have been trying to help Grace as much to build a relationship with her, if not more, than to solve the mathematical task. When we teach, we may not have access to how our students think about their engagement, but these principles of motivation can provide us with lenses for seeing why they might engage as they do.

Research literature describes adolescents’ motivation as a process of simultaneously managing both academic and social goals (Dowson and McInerney 2003). When working together in mathematics, students not only try to learn mathematics, but also seek social affiliation, status among their peers, social approval, social responsibility, or they act out of social concern. These are just a few social motivations to which students might respond in a classroom. We can adapt each of these motivations positively to working well in a group—by which we mean the group works harmoniously toward common ends, not that the group necessarily works together to learn mathematics—and therefore to being prosocial. The extent to which this classroom’s prosocial goals aligned with its goals for learning is a telling feature. In the homogeneous group, the social norms reinforced Grace’s learning and that of the other girls. It maintained all the positive characteristics of cooperative learning (Slavin 1981).

An additional explanation for the difference in Grace’s behavior between the two groups may be gender. A clear difference between the two groups was that Grace was the only girl in the group when she was less engaged, and she was among other girls when she was more engaged. This may have been coincidence, because Grace’s engagement may depend on which girls and which boys were in the groups with her, as contrasted with whether or not Grace was with all boys or all girls. Her more subdued learning behavior may have been due to feeling like the only different group member; perhaps having one more girl in the group with her would have helped her want to engage. Again, if we were Mr. Lawson, we would not know for sure whether gender could explain the differences in Grace’s engagement, but we might wonder about it.

Belenky and colleagues (1986) show us that some learners may be more interested in engaging in classroom activities to relate with their peers. This type of engagement has been described as “connected” knowing. Some researchers have
found gender patterns, such that females prefer connected ways of knowing, but these preferences do not necessarily follow gender lines consistently. In a conversation with Jim about motivation, Randy Phillipp, a colleague from San Diego State University, made the analogy that for many children, doing mathematics is like doing dishes. “I hate doing the dishes,” he stated, “but when I do the dishes with Margaret (Randy’s wife), I love it.” We have all somehow experienced this connected learning. Nonetheless, some young women are less motivated for relational reasons, and some young men are more motivated for them. However, through exploring women’s ways of knowing, researchers have learned that allowing students to work in groups can help learners achieve connectedness and come to know through relating with others (Noddings 1989). The benefits for learning of well-orchestrated cooperative learning environments are well documented (Slavin 1981).

Another explanation for the difference in Grace’s behavior could have been her level of familiarity with the girls compared to her degree of familiarity with the boys. This may not be the best explanation for her behavior, because both groups in the story were new to her. However, the group with girls included one person with whom Grace had worked recently—Janey. Having just one familiar group member could have helped Grace feel more comfortable engaging deeply in the mathematics in that group. Groups may not function at their highest potential when first formed, because of a lack of comfort with a novel group composition. Having one familiar group member with whom the student is comfortable might lead to stronger engagement with mathematics during the group work.

Finally, each group in a classroom will develop its own microculture, depending on the group members’ dispositions and knowledge and how they interact. The group with boys appeared to value getting to the correct answer rather than trying to understand one another’s thinking. This microculture differed markedly from that of the group of girls. The girls tried to understand one another’s thinking, to the point where they did not mind engaging in mathematical argumentation with one another. So, Grace’s behavior may have differed depending on the microculture that developed in each group.

In her attempts to fit in to the two groups’ different social settings, Grace altered her behavior in remarkably adaptive ways. At one moment, social and mathematically engaged, Grace used the first group’s rules to learn the content actively. In the next moment, after unsuccessfully attempting to reorganize her group by making contact with her friends, Grace resigned herself to the second group’s rules to maintain order and status. As a consequence, her learning and attitude suffered.

We shared a wide range of possible explanations for Grace’s engagement—through the principles that motivation is adaptive and social—to demonstrate how the principles can help us thinking about students’ motivation. We also want to acknowledge that, if we were Mr. Lawson, we wouldn’t know for sure why Grace behaved as she did. We want to demonstrate that the principles could allow us to think about Grace’s behavior from multiple perspectives. Similarly, we will reflect
next on Grace’s engagement and Mr. Lawson’s classroom through another motivation principle: success matters.

**Success Matters**

*Students are motivated to participate in mathematics classroom discussions partially to demonstrate their mathematical competence and partially to gain status among their peers.* When we introduced this principle, we referred to the tension between attributing success to hard work and ability and needing social comparison—specifically, to feel competent relative to our peers, not just to be competent—as a dance. Grace performed this dance typically for an adolescent girl in mathematics class. She wanted to show others that she knew and understood mathematics when she contributed to class discussions. When Grace worked with a group of girls and had a different solution from one of her peers, the group worked together to determine which solution was correct. The group found Grace’s mistake, and Grace could be more certain about her solution once her peers helped her correct it. Working with peers to discuss her solutions gave her an opportunity (1) to understand whether and why her solution was correct and (2) to feel confident about her solution. When she shared her thinking aloud with the class, she spoke in a manner that allowed her to enact her sense of competence.

Research on students’ motivation has discussed the motivation to appear competent under a variety of names. Two examples of terms that describe student’s motivation to appear competent are ego orientation (Nicholls et al. 1990) and performance-approach goals (Midgley, Kaplan, and Middleton 2001). Ego and performance-approach goals govern when students actively work to appear superior to others by demonstrating competence. These goals contrast with mastery goals, when the student desires to obtain understanding. A third category of goals related to performance, performance-avoidance goals, show a disturbing pattern. Because students evoke performance-avoidance goals when they want to avoid demonstrating a lack of understanding, they tend to shut down, deflect attention, and engage in tasks only with tremendous anxiety.

Grace may have been motivated to work with her peers to resolve their mathematical conflict because she anticipated that her teacher could call on her. The students knew that their teacher could call on any student at any time. Students who were aware of this expectation and were interested in appearing competent would likely be motivated to seek reassurance that their answers were accurate and their solutions reasonable during group work. Grace wanted to be certain that she was correct so that she would be prepared to demonstrate her mathematical competence if Mr. Lawson called on her.

It is relevant to consider that Grace is an adolescent, and adolescents tend toward heightened desire to appear competent in front of others. David Elkind (1967) wrote about adolescents’ construction of an imaginary audience. This is when adolescents, in the process of starting to think more about their own thinking, believe that others are
thinking about them as much as they are thinking about themselves. So, we might expect someone at Grace's age to be concerned about appearing competent. When we think back on our own feelings as adolescents, we can empathize with Grace.

However, we can also see that Grace's interest in demonstrating competence makes sense when we think about the competitive culture of her classroom. Her classmates were all relatively strong in mathematics, and the students had established a sense of competition among groups. They attained social status in their classroom culture by efficiently achieving a sensible and accurate solution, and they maintained that status through opportunities to share sensible and accurate solutions publicly. Although adolescents may be concerned already with appearing competent in front of their peers and teachers, this classroom's culture potentially intensified these adolescents' needs to appear competent.

It is also possible that the performance-approach goals that motivated Grace were not necessarily problematic. On the basis of their review of research literature, Midgley, Kaplan, and Middleton (2001) described conditions that facilitated learning when students held performance-approach goals. One of these conditions included a competitive classroom in which mastery goals were also present. In essence, by emphasizing understanding and sense making, Mr. Lawson's pedagogy supported the development of mastery goals. This emphasis on understanding focused competition, at least in Grace's first group, on developing the best strategies and explanations as opposed to coming up quickly and efficiently with a numeric answer. In this classroom, students appeared to be motivated to appear competent and achieve mathematical understanding simultaneously.

Below, we discuss how, in light of these motivation principles, teachers might think about and respond to events in this story. We provide some implications for teaching mathematics. When we interpreted Mr. Lawson's classroom and Grace's behavior through the principles of students' motivation above, we did not give clear answers. Instead, we entertained multiple interpretations. Similarly, when we share how teachers might respond to or think about a situation similar to this classroom, with a student like Grace, we do not offer prescriptions for practice. Answers for how to respond to students are rarely clear. Instead, we explore a range of possible responses that a teacher might have to situations presented in our chapters' stories.

**Grace's Story: Implications for Classroom Practice**

Throughout this book, we explore implications for practice inspired by each student's story. In our experience, teachers want to support students' engagement in a manner that both facilitates mathematical understanding and promotes longer-term engagement with mathematics. We discuss implications in this chapter in the form of presented dilemmas, because we believe that no easy answers exist when making
instructional decisions. We want to honor the complexity of a classroom’s dynamics and acknowledge that addressing one element of a student’s experience may perturb another, equally important element. Such was true of Mr. Lawson’s decision to move Grace from one small group to a second and then to a third.

Dilemma: Should Mr. Lawson keep Grace in the group in which she appears to be motivated or help Grace develop a more flexible engagement with mathematics that isn’t tied to group membership?

In this instance, perhaps we should rephrase the question. If students can learn mathematics through engaging in dialogue with their peers, then Grace may not be the one who needs to change. Rather than try to help Grace be motivated in multiple contexts, Mr. Lawson could consider how to help other students engage like the members of Grace’s group. A new question could be How can more groups function to be more like Grace’s group when she worked with the group of all girls?

Marlene Scardamalia and Carl Bereiter (2006) talk about classrooms as “knowledge-building environments.” Their belief is that the classroom’s social makeup should be explicitly designed such that each student feels responsible to build a better, more coherent, more efficient knowledge structure, both for themselves and for the class. This ethic combines the best aspects of both mastery goals and connected-learning goals to create an environment where all individual, contributing class members’ needs for competence, recognition, and relatedness actually support and enhance one another.

Mr. Lawson’s new dilemma becomes how to support groups’ interactions in a truly collaborative manner. (See chapter 12 for more on this topic.) Some teachers have tried to foster collaborative interactions through group assessments. Others have tried holding all group members responsible for the group’s thinking, such that no one could ask the teacher a question until all group members have thought about the question first; the teacher could call on any student to present the group’s thinking during a class discussion. These are both good strategies that help, but do not solve, the dilemma by themselves.

The fourth motivation principle states, Motivation creates long-term attitudes. To accomplish this positively, Scardamalia and Bereiter (2006) suggest that the bulk of classroom practices must align in several important ways:

1. Understanding knowledge advancement as a community achievement rather than merely an individual one
2. Defining knowledge advancement as the improvement of ideas, rather than as progress toward true or warranted belief
3. Defining the knowledge of mathematical concepts and their applications as opposed to knowledge about concepts or applications
4. Promoting discourse as collaborative problem solving—argument rather than argumentation

Using strategies to promote these values for collaborative activity across groups could have a promising impact on students. Emphasizing the importance of collaboration can help students meet their social goals as they simultaneously work to meet academic learning goals. If a value for collaboration is in place across the classroom, then Grace's motivation to engage in mathematics is less likely to appear different depending upon the members of her group.

Dilemma: Should Mr. Lawson support Grace in her need to feel competent before participating, or should he encourage Grace and her peers to see the value in participating in mathematical discussion, even if they are not certain they are correct?

Resolving conflicts during small-group work allows students to feel more competent to display correct solutions and sensible strategies during whole-class discussions, but the larger group may have fewer opportunities to learn from one another if students resolve conflicts during small-group work. Teachers may believe that learning is a process of constructing meaning together through dialogue with others, but some students may be less open to learning from others during the conversation. They thus may present ideas to the class only after the ideas are fully developed. Students who prioritize the need to feel competent in front of their peers may want to avoid letting their peers know that they are uncertain about their thinking. Students could benefit from the teacher bringing uncertainty about a mathematical understanding to the large group for discussion, so that the class can work together and wrestle with the uncertainty as a group.

One way to resolve this dilemma is for teachers to push students on what counts as “mathematically competent” in the classroom. For instance, the students may think that competence in mathematics looks like sharing a correct strategy. Alternatively, mathematical competence might consist of asking thoughtful questions, such as “I wonder why these two answers are different? How did we solve the problem differently to get to these two different answers?” If asking a thoughtful question is a form of mathematical competence, then students do not need to be sure that they are correct prior to participating, and therefore participation has more positive rewards than potentially embarrassing mistakes.

If more ways to be mathematically competent exist, then more students have the chance to be considered mathematically competent. If teachers use multiple ways of appearing competent in mathematics, then they can tailor assigning competence to specific students individually and thus raise more students’ status in the classroom (Boaler and Staples 2008; Cohen 1994).
Why It Matters to Understand the Reasons Students Do What They Do

Summary

The first author (Middleton and Spanias 2002) wrote, “teachers matter” when it comes to creating positive learning environments—knowledge building environments—that enable students to become motivated to learn challenging mathematical concepts and skills. Our future depends on teachers who are capable of seeing through all the potentially conflicting motivations students bring with them to the classroom, who are capable of designing tasks, of orchestrating discourse, of seeing the potential in each and every one of their students and matching that potential with learning experiences that stimulate the student to maximize what they have been given. Teachers matter. Students learn to like or dislike mathematics, to see it as part of their future, or to see it as an endeavor to be avoided, and that learning takes place, for the most part, in classrooms led by teachers. The principles and strategies we share in this book will provide opportunities for mindful teachers to change their practice and affect that learning to be positive, yielding mathematically proficient, mathematically disposed knowledge workers. Let us now jump right in and examine those principles and strategies in action.

References


