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Teaching middle school mathematics, I have found that classroom dynamics have a profound impact on the quality of mathematical discussion. Wanting to improve classroom discussion in order to better facilitate both small-group and student-driven learning, I started the school year by randomly grouping students every week for their small groups. I then studied student interactions and perceptions of student status, as well as my facilitation of group discussion over the course of the year. In this article, I describe my deep dive into student relationships, classroom culture, and mathematical discourse for one class of seventh grade students.

Social Justice and Classroom Culture

Math education is a social justice issue, with disparities in math education contributing to societal inequities. For instance, people of color are underrepresented in highly skilled tech fields (Landivar, 2013); early exposure to innovation (as can be reflected, I believe, in math experiences) informs the creation of inventions later in life, disproportionately resulting in White male inventors from high-income backgrounds (Bell, Chetty, Jaravel, Petkova, & Van Reenan, 2017). Many students in have been subjected to drill-and-kill routines in response to increased and increasingly high-stakes standardized testing, particularly in urban schools. Mathematics, on the other hand, can also provide students with lenses for examining and tools for combating systemic disparities, as Gutstein and Peterson (2005) and Gutiérrez (2002) have proposed and facilitated in recent decades. However, beyond test results and curricular decisions, the math classroom is an incubator for human interactions with profound equity implications, and these are the moments that invariably fire me up and keep me up at night as I consider their impact on my students.

This interactional facet of mathematical social justice prepares young people to be citizens in a democratic society. Anderson (1999) refers to this as democratic equity, which relates to a person's social standing in society. Unfortunately, many classrooms today replicate society as it is now rather than society as we want it to be. We see hierarchies develop that create "haves" and "have nots," just as we see people who are considered more and less valuable. I find that this acquisitional approach to ability pervades math settings, because American society tends to see math as binary: either you have the ability or you don't. People who can think as quickly and precisely as a computer are considered brainy while others wave off their math woes casually with, "I'm just not a math person" or "I don't have the math gene." Unfounded genetic claims aside, if we want to develop a more democratic society, individuals need to see themselves as equal in status to those people around them (Anderson, 1999). Math class can become a place for this to occur if we value the different abilities and ideas that each person brings to the space. If young people have lasting experiences in equitable math classes, hopefully, they can transfer these ideas to other environments both now and later in life. The kinds of skills that students

learn in class support a multidimensional approach to solving complex social problems, because no real problem can be solved using just one perspective or idea (Shweder, 2003). It takes many different people listening to each other in order to synthesize the best solution for the most people. Math class truly can be a training ground for the future of democracy.

My Study

My goal was to develop a class culture that fosters *relational equity*, which was described by Boaler (2006) as the equity demonstrated in student peer interactions. She states the admirable characteristics are: "1. respect for other people's ideas, leading to positive intellectual relations; 2. commitment to the learning of others; and 3. learned methods of communication and support" (p. 174). It is fostered by classroom relationships and a supportive culture, and can have a lasting impact on people's future interactions, as well as their sense of themselves as agents of knowledge. Describing a longitudinal study of a school that she used to develop her definition of relational equity, Boaler (2008) writes:

> Students learned to appreciate the contributions of different students, from many different cultural groups and with many different characteristics and perspectives. It seemed to me that the students learned something extremely important that would serve them and others well in their future interactions in society, which is not captured in conceptions of equity that deal only with test scores or treatment in schools. (p. 45)

My project focused on developing these same outcomes in my classroom interactions, particularly through small group discourse. Recognizing that my students have not spent a lot of time engaging in discussion-based learning in their previous classes, I looked to math education schools of thought that focus on supporting small group intellectual communities while disrupting status hierarchies. My primary frameworks were Peter Liljedahl's (2016) thinking classroom and Elizabeth Cohen's (2014) complex instruction theories. Within these parameters I sought answers to the following questions:

- What happens when I group students randomly in a middle grade math classroom?
- What do I learn about status hierarchies in my classroom?
- What strategies do I find myself using to support group discussion?
- In what ways, if any, does relational equity develop?

I was curious about how my ideas about individual students would change as students experienced scaffolds to support discussion in their randomly assigned groups. I hoped that students would surprise each other and me with the ideas and strengths that they brought to their groups. Early this year, a skeptical mother asked me to explain how my class works. Hearing about the class from her daughter and noticing teamwork scores listed in the grades, she wanted to know if I show students how to do problems before I ask them to try. My answer was that I do it the other way around, asking students to first try a problem on their own, then collaborate with their team, and then I pull it together in a group discussion before students approach more problems. She seemed unconvinced by this "new" way of doing math, but she was willing to listen and learn more, which I appreciated since I was still skeptical myself about how well it was working in my classroom!

Context of the Study: Messages Matter

I am the sole math teacher at a small middle school where everybody knows everybody. Classes are departmentalized, but students travel in heterogeneous (untracked) cohorts, and they spend their entire day, minus lunch, recess, and perhaps study hall, with the same group of fifteen to thirty children. This results, for better or for worse, in groups of students who know each other very well across settings.

The middle school is part of a charter network that describes itself as a "superhighway" from PreK to college. We are proud of our recent years' 100% college acceptance rates and the amount of financial aid that the network's college counseling office secures for graduating seniors. This college-bound emphasis permeates our current school culture from the youngest students up, and is rooted in our context: situated on Chicago's South Side, the network serves an almost entirely Black student population, many of whom will be first-generation college students.

Notwithstanding the network's laudable goal for this traditionally underserved population, my school assigns failing grades to a significant number of Black students, particularly boys. The school encourages teachers to innovate around problem-based, project-based, and social justice learning, but, institutionally, we struggle to maintain a tight balancing act around high academic and behavioral expectations of students and developmentally appropriate pedagogy and policies for young adolescents.

The importance of academic achievement is a daily message our students receive. We focus on grades and attendance, with a heavy emphasis on grades. Students track their GPA during weekly advisory meetings and can access their grades via a website and phone app; some of them get phone notifications as soon as their letter grade for a class changes.

Many school-wide rewards are based on grades, meaning students are constantly reminded about who is "on track" for academic success, which is our school's primary method for celebrating individuals. For example, students can be out of uniform on Fridays if they have a 3.0 GPA and no failing grades; student eligibility for incentive trips is determined in part by grades; and students who have a 3.0 and no Fs get free entry to school dances. Despite these rewards, only about a third of our students routinely get there. As students look at the publicly posted lists each week, they see who consistently gets the prizes and who is absent from those lists. Even students who are celebrated for other skills, like being members of sports teams, are often excluded from events if they are failing a class. I haven't decided on my personal stance about event exclusion for grades, but I know that it sends a message to students about what kind of success is most valued.

The distinction is most telling at our end-of-semester awards ceremonies. Amid numerous certificates that are handed out for things like perfect attendance and kindness, the awards that most stand out are the exclusive Excellence and Grit Awards that teachers give to one or two students. While the Grit Awards celebrate hard work and are often phrased as "turning it around" from a low grade in some way, the Excellence Awards are the most coveted evidence of a student's academic standing. Unfortunately, these awards often celebrate the same students,

either across semesters or sometimes even within the same semester across classes. After our first semester award ceremony this year, a seventh grader complained that all the awards go to the same kids, and looking at the spread, we had to agree and promise to do better. Who is "making it" and who isn't becomes obvious to students through the posted lists, award ceremonies, and constant reminders to check their grades. While grades should reflect the effort that students put in, many adolescents see them as a reflection of general smartness, a personal label of "good" or "bad" at school.

Even more troubling, in my opinion, is the correlation between grades and behavior, further creating a system of categorizing students. Many of our students with the lowest grades, particularly our boys, are the same students receiving the most demerits, leading to weekly detentions and other consequences. "Smart," "hard-working," and "compliant" are often conflated, while "bad students" are both low performers in class (often with poor homework habits and less developed executive functioning skills) and receive the most negative feedback about their behavior. These implicit labels become obvious to peers, who see the same students receiving consequences in class after class.

Academic issues sometimes come to a head with the most damning label for a student: retained. If students receive a certain number of failing grades in core classes, they are automatically retained, meaning they repeat the entire grade. Our retention policy has historically disproportionately impacted boys, and coming into this year, the disparity was even more striking than usual. The year of my study, the school's 67 math students included four boys who were retained in sixth grade and four who were retained in seventh grade. None of the 31 girls were retained. Additionally, two boys were currently in the eighth grade because they were too old to retain in seventh grade, and two boys transferred out of the school rather than repeat seventh grade with us. In such a small school, it is obvious when someone repeats a grade, and I have heard students reference retentions to students who have been held back. Nothing says you're a failure like failing a grade, especially in a school that worships academic success.

The Study Participants

Within this context, meet my focus class, one of three seventh grade cohorts. Before learning much more about my twenty-two (later twenty-three) students, 15 boys and eight girls, I knew that at least five students (all boys) had been retained in the past (two in sixth grade, two in seventh, and one in elementary school). There may have been others retained in elementary school that I was not informed of. Five students were members of a "gifted" program. Two boys were diverse learners with IEPs, mandating a co-teacher in the classroom. Three students were diverse learners with 504 plans for ADHD that manifested in different ways. Multiple students had been described to me as having behavior problems in sixth grade. And there were other students I had heard nothing at all about.

So here we are in August, sitting in a complexly heterogeneous classroom, in a very socially aware, status-savvy middle school, and I'm carrying my own baggage. Seventh grade in Chicago is, scarily enough, a gatekeeper year in a young person's life, determining how many options they have later. Their grades and standardized test scores largely decide their high school fate, which affects their college choices, which impacts the rest of their life. I find this fact very

troubling. What twelve-year-old is thinking about how their decisions in one class will determine the rest of their life? While I try not to drill such a deterministic message into kids' brains (beyond emphasizing that academic growth, measured in grades and test scores, helps a person have options) it is always a hum in the back of mine. Given only four class periods for math each week and a sense of impending doom as spring standardized tests approach, I dread "wasting" time that doesn't feel directly mathematical.

Changing Math Expectations: The Evolution of Small Group Work

I needed to make my mathematical time as efficient as possible, and I've learned something important in my first few years of teaching: I'm pretty boring. Five seconds after I start talking, kids often start tuning me out. And that's fine by me, because I don't think watching math being done is nearly as powerful as *doing math*. So after two years of lecturing and showing, I decided to focus instead on getting kids talking confidently and copiously about their mathematical thinking while working in small groups, and study this process as well. My goal was to do better at developing students as collaborative creators of math knowledge whose small-group work could drive our full-group discussions. I also wanted to see students who could more productively manage disagreements and interpersonal conflicts in their groups. These were lofty goals; my efforts in reaching them, even after several years, are still in the process of evolving.

Looking back over my first two years of teaching, I realized I created groups to keep certain students apart, put other students together, and play with group dynamics. I was operating out of fear of losing control. I was more concerned with my anxieties about classroom management than I was with how the groups I formed would actually discuss mathematics. This didn't develop my students to be productive group members, both because they didn't understand how I was grouping them and because they didn't have opportunities to reflect on their group membership and improve their discourse. Worse still, in situations like this, students often assume that they have been put into a group as the "low" kid who needs help, or to be isolated from their friends, or to be the "teacher," and these ideas about teacher expectations (which often are at least partially accurate) then inform how the student acts in their team. So, I had this conversation with my students, by asking if my assumptions about their assumptions were on target. There was vigorous agreement about feeling like the "slow" student; interestingly, there was less commotion about feeling like they had been assigned a table to be the "teacher." This really made me think about the messages I send when so many students have felt like they were seen as the weakest link in a group.

To avoid the burden of teacher expectations, I let students choose their groups, and I focused more on training them around building productive working groups as I assessed their math talk. I assessed group discussion using a rubric and pointing out positive group behaviors as I observed them. My students' group choices were not ideal. Liljedahl (2016) cites evidence that students often group themselves according to social goals that misalign with education goals, leading to conditions where both teacher and students are unhappy with the outcomes. I observed this tension in action as students who knew they could not work productively with each other would still choose to sit by the same people. Without explicit learning about what makes a good team, expecting students to make the choices I would make for them proved unrealistic. I recognized

that if I want to minimize full-group instruction, I needed to make collaborative group time much more productive than it had historically been in my class.

Around this same time, I went to a professional development "math camp" (it's as nerdy as it sounds) and experienced something new. In almost every session, I was randomly assigned to a new group. It kept me on my toes and prevented me from settling into the perceived comfort of a familiar group. It was equal parts disorienting and exhilarating. Being math teachers teaching math teachers, our facilitators explained their purpose: visibly random grouping. This alternative grouping strategy, proposed by Liljedahl (2016), intrigued me. It disrupts teacher and peer ideas about student roles in the classroom and sends a message that productive discourse is not person-dependent. Random grouping, theoretically, allows students to take authentic ownership of their group, because the dynamics are a blank slate…. except, as already mentioned, my kids already have been sent a lot of messages about themselves and each other. That's my challenge.

In my classroom, visible randomized grouping is organized by my holding a deck of cards out to students on Mondays and students sitting at the tables that match their cards. Liljedahl (2016) stresses the importance of the *visibility* of the randomization. His research shows that when students didn't see the groupings being made, they still believed there was a hidden agenda, and the questions about teacher expectations and ideas about their role in the teams still surfaced, interfering with students forming fresh socio-mathematical relationships with each other.

Every Monday, as I'm pulling the cards out to hand to students at the door, I get a nervous tingle. To be honest, it's less "Is there going to be a messy group this week?" and more "Which group will be the messy group this week?" Will one of my talkers end up in a group that harnesses their energy productively, or will chance thrust them into a distracting paradise of fellow talkers?

Thinking Classrooms

Although my school encourages status hierarchies with its public focus on grades as a marker of academic success, it provides a foundation for relational equity by grouping students in cohorts heterogeneously. Students are assigned a cohort that they follow to every class and these cohorts are not ability-grouped for any subject. Schools that create tracked classes inevitably obstruct relational equity because they set up a school status hierarchy of ability before students even set foot in a classroom. Boaler (2000) performed a longitudinal study and found that ability grouping in six schools was associated with curriculum polarization--that is, more drill-and-kill in lower tracks and an artificially rushed pace in higher tracks--and students who were unhappy with their placement. Further, she found that students in lower tracks had low expectations for themselves and the work they were doing, suggesting that students tend to internalize the status that has been imposed upon them. On the other hand, Boaler (2008) found that schools using mixed-ability approaches experienced both higher academic attainment and greater relational equity. Her main case study for this research was an urban high school in California that was both culturally and racially diverse (with 80% students of color), with a large number of English Language Learners. She found reduced inequities in this school, compared to other schools that traditionally tracked students.

My school's structural choice lays a good foundation. Other than the one "gifted" program that pulls students from study hall, students do not see their class assignment as a reflection of their ability in any particular subject. Status hierarchies do, however, still quickly develop as students interact, with some students labeled by peers (sometimes openly) as "slow" while others are lauded as "the smartest." I wanted to dismantle these hierarchies and build relational equity in a heterogeneous classroom designed around small teams, keeping in mind the perennial concern with group work as noted by Boaler (2006): that just having students do group work does not make it productive if some students do more work than others or if some students are excluded or opt out of the critical thinking. One strategy is to intentionally group students, pairing personalities and perceived abilities the teacher thinks will be compatible and intellectually stimulating. As I have already admitted, I tried and then rejected this strategy for that of Liljedahl (2016).

After a decade observing classrooms, Liljedahl (2016) developed some prescriptions for developing what he calls a *thinking classroom*. Group formation is one of his proposed nine classroom elements to consider. He describes a thinking classroom as one with sociomathematical norms that encourage students to persist and to value each other's ideas.

Productive problem solving is the end goal for most math classes, even if the methods seen don't always seem to fit that goal. When students develop procedures for computation, we want them to use these flexibly, in tandem, and in novel situations. Rich problems, just like complex social problems, are generally most effectively addressed when approached by multiple people, because the multidimensional nature of the problems encourage different perspectives and strategies from different members of the group. Implementing these problems and provoking productive student struggle, however, can be challenging unless classroom norms have empowered students to think.

Complex Instruction

My experience with visible random grouping showed me that just grouping students randomly isn't enough to develop productive group dynamics. It needs to be paired with intentional moves to train students to have math conversations with anyone, whether they like them, don't like them, or like them too much. I began by assessing students around discourse moves, such as coming to discussion with something prepared on paper and making progress throughout small group work (criteria that I developed with a colleague over the summer and used ClassDojo, classdojo.com, to track) but it felt like I was assigning plusses and minuses rather than coaching students through the complications of middle school social relationships and class status markers to a more productive math dialogue. In some ways, I felt like I was simply reinforcing students' ideas about "good" and "bad" group members or groups.

Although Liljedahl (2016) suggests randomizing groups every class period in the secondary setting, I chose longer grouping periods for my middle schoolers because I also wanted to develop student capacity for discussion strategies, and I wanted to give kids time to grow into their group and appreciate what the team can do together. Exposing students to many peers and freeing them from my grouping expectations may help with some status issues, but it isn't a panacea. Students who don't feel confident often hide, and this becomes more obvious in small

groups and can exacerbate status issues, resulting in negative feedback from peers about these students' group participation. Kids who are more confident, generally due to higher status, tend to start group conversations, and this leads them to become increasingly influential in the conversation, further reinforcing their high status. Greater involvement in conceptual tasks will likely lead to deeper learning from the group interactions, generating a cycle of ever-widening status and learning gaps. Status issues can also interfere with learning more generally, if people of low status are hesitant or ignored, or if people with high status are treated as experts even if they are in fact confused in their thinking (Cohen & Lotan, 2014). When students were responding to their random assignments with groans, gleeful exclamations of how "smart" their tablemates were, or requests to change tables, I knew that more thought on the complexity of my instruction was required.

Cohen (2014) began developing her ideas about instruction and powerful group work three decades ago. What she called *complex instruction* has become a school of thought espoused by math educators across the country and beyond. The third edition of Cohen and Lotan's (2014) book has become a treatise on this type of teaching. Boaler (2006) describes the aim of complex instruction as a counter to status differences that emerge in classrooms during group interactions. It requires the teacher to responsibly delegate authority in the classroom. Cohen and Lotan write, "delegating authority does not mean that the learning process is uncontrolled" (p. 2). Groups can struggle if they have a hard time focusing, end up excluding someone, or relinquish all the responsibility and thinking to one or two people. This is where I want to be explicit in my instruction. When I say explicit, I don't just mean teaching lessons on discussion stems, although that can be a component. I want to make certain behaviors visible to small groups and to the whole class in order to unambiguously say that they are productive behaviors. In this way, I want students to become models for each other, and I can model positive sociomathematical norms at the same time. A responsible delegation of authority requires me to shift my role and refocus my lens on not just the math that groups are doing but the ways in which they are discussing it. It necessitates choosing my words wisely, because I want to use them infrequently and for greatest effect, raising the status of lower status students whenever possible.

As the continual analysis of classroom data necessitated a continual evolution of the group work strategy in my classroom, I often referred to literature for advice. Throughout the year my understanding of complex instruction deepened. There are multidimensional aspects of problem solving, both in classrooms and in a democratic society; complex instruction focuses on a multidimensional classroom--a space in which different student perspectives, skills, and roles are required and respected across activities. The particular elements of a multidimensional classroom that became important during the year were a multiple ability treatment, use of team roles, assigning competence, and group-worthy tasks.

Multiple ability treatment. Multiple ability treatment in a multidimensional classroom acknowledges that many math classes treat math as unidimensional: computational efficiency makes the mathematician. Instead, this approach proposes opening up task requirements to make them more group-worthy. This means adapting problems to value many different abilities and then explicitly sending a message to students that no one person alone will be good at all of the abilities needed to solve the problems, but that everyone will have something to bring to the problem. Cohen (2014) and other math educators and researchers have proposed strategies for

opening up tasks. I tried a number of them, such as opening up scenarios to noticing and wondering, removing text from scenarios in order to allow for multiple interpretations, and making problems and solutions visual in order to clearly allow for and show differences in thinking. These can lead to relational equity as students begin to see the completely different ways that their peers see problems as well as the insights those different perspectives yield.

Team roles. Team roles were not new to me, but I embraced them more fully during the year in an attempt to provide structures for students to navigate teams that were not naturally productive in nature. Cohen and Lotan's (2014) interpretation of team roles is that they need to be assigned so that all students have important work to do in the group in order for it to function. There shouldn't be a busy-work team role just so everybody has one. This requires determining both what issues are most relevant for a particular class and how students can be assigned roles that address those issues in meaningful ways. Initially, I adapted team roles developed by organizations like YouCubed (www.youcubed.org) to my particular concerns and randomly assigned a Captain (to help keep the conversation on track), Counselor (to check for equitable discussion), Communications Officer (to facilitate communication with the teacher and other teams), and Chief Engineer (to consider and acquire appropriate tools). My teams generally have three people in them, although one team usually has four people, and this challenged me to consider how to have four roles that were all important when two needed to be held by the same person. As I will describe, my team role assignments evolved in response to subsequent insights.

Assigning competence. The element of assigning competence by using my words infrequently and wisely whenever possible became one of my greatest weapons in the fight against status hierarchies in my classroom. Also calling this method "status treatment," Cohen and Lotan (2014) suggest raising the status of students by identifying their contributions in either the small group or with the whole class and recognizing its intellectual value. This can be done by selecting students to present their ideas or by the teacher praising something a student has offered. However the information is relayed, it needs to be public, intellectually-based, specific, and relevant to the task at hand, because this will explicitly educate all students about the different dimensions that I value, relate it to the mathematical work, and illustrate the academic value of the student's contribution. The hope is that students will revise their ideas about their peers, and themselves, as they receive more and more positive feedback about their intellectual ability. I learned that this is one thing that I must push myself to do, non-negotiably, as often as possible, because academic status hierarchies are pervasive and move across subjects. This means there is a powerful structure to attempt to shift, and because students of lower status will often participate less, this can make them less visible to me as well. I must be constantly vigilant.

Group-worthy tasks. A fourth dimension of complex instruction was the use of "group-worthy" tasks that are complex and open-ended enough to elicit different strategies, creative responses, and argument. While finding, adapting, or creating these tasks is something that I spend lots of time doing, I didn't focus as much on instructional tasks themselves in my study. My questions remained:

- What happens when I group students randomly in a middle grade math classroom?
- What do I learn about status hierarchies in my classroom?
- What strategies do I find myself using to support group discussion?
- In what ways, if any, does relational equity develop?

Nonetheless, the nature of the task inevitably affected how students interacted with the mathematics and with their teammates, as I will describe.

Data Collection Methods: Observation for Iteration

As a designer of (hopefully) a more equitable math discussion experience for a very specific group of people, I entered the school year with some background knowledge but not yet a deep understanding of my classroom ecosystem. I knew my school, but I needed to learn about my specific group of students, as well as gather feedback around my design choices, primarily random grouping to start. My classroom strategies to promote equitable and accountable team discussion evolved through an iterative process driven by feedback that I received from students, case studies of four students in particular, and my own reflection on classroom snafus and successes. The following data collection methods were most informative in helping me to focus and shift my perspectives on what was happening in my classroom.

Teacher Journal

In the journal I reflected on my day and gathered observations about individuals, groups, and my responses to them. It also provided a record of my strategy implementation and a rough narrative of my iterative process, as well as allowed me to see the ways that my ideas about students evolved (or didn't) throughout the year.

Video Observations

During group tests, when students were charged with working out problems first individually and then collectively, I recorded one-minute samples of team discussions in order to examine team participation and math discourse in a setting when students felt a sense of urgency around the accuracy of their work. It also allowed me to step back completely and record, since students generally didn't ask me questions in a test setting.

Team Reflections

Students completed individual weekly team reflections, which provided me with information about how students viewed their teammates' contributions. As an instructional bonus, this offered an opportunity for students to develop their metacognition around team learning.

Student Surveys

I surveyed students at the start of the year to use the data to make instructional changes early. I again surveyed students near the end of the year to look for changes in student responses to the same questions; plus I added in questions asking about their favorite part of the year and least favorite part about working in teams in order to elicit more pro and con statements. While my initial survey was anonymous, I collected student information in the final survey so I could reflect on my four case study students in particular. For both surveys, I used Google forms and coded student responses for representative themes.

Interviews

I recorded interviews with three of my four case study students midway through the second semester. Their feedback was informative about both how they experienced team learning and how they viewed themselves and their cohort in general.

Case Studies: Selection and Artifacts

Although it is hard to untangle my study of individual students from my experience with my whole focus class, I paid close attention to four students whom I had selected to use for case studies. I chose these students based on their appearance of being lower status for different reasons.

Jason repeated sixth grade, and I had heard that he was a very quiet student. This led me to predict that he would have a lower status both academically and socially in the classroom. Upon entering seventh grade, it quickly became clear to me he had a strong math foundation but that he didn't like to speak in class. I wondered how students would interact with him in groups and how his participation in groups might change over the course of the year if he was given frequent opportunities to show off his mathematical understandings.

> *How can I get Jason more excited?*
> *- First journal entry about Jason*

Darwin repeated seventh grade, and I knew that he had been avoided by groups during the previous school year. I wanted to see how things would play out in my classroom the second time, particularly given that I knew he had a lot of mathematical knowledge but poor work completion habits, the major reason for his retention.

> *Darwin feels more mathematically mature than other students. I don't know if it's because this is his second time interacting with 7th grade math (although I didn't use the same lessons last year) or something else, but he seems to notice patterns and be more flexible with numeracy than most of his classmates.*
> *- First journal entry about Darwin*

Anna quickly showed up on my radar because she expressed deeply low self-esteem around mathematics, repeatedly telling me that she couldn't do things like long division even after she had just successfully used long division. She also had a 504 plan with accommodations for attention issues, and she deflected academic attention from herself whenever possible.

> *Energy can wax and wane through the period, particularly since I have some students who tend to appear low-energy no matter when I see them, like Anna.*
> *- First journal entry about Anna*

Sam initially caught my attention specifically because she so often faded into the background. One of the quietest students in the classroom, she also exhibited a lot of confusion around mathematical concepts in her written work, and I wondered how her team participation might impact her self-efficacy.

> *Sam responds strongly to negative feedback, so I have been working on modulating how I give her criticism and redirect her, because I don't want it to impact how she then experiences the class time afterward. I'm not sure if she spoke in full group this week.*
> - *First journal entry about Sam*

Designing Discussion: Data Informed Iteration and My Ethnographic Journey

As I consider my year of implementing visual random grouping, I have simplified the journey into four general (unequally spaced) quarters, distinguished by my overall focus during each period of time. After an initial period of time piloting randomized grouping, I followed with three iterations informed by my ethnographic findings during the previous quarter. In each section, I discuss my strategy implementations, my data (mostly from my case study cohort but with some broader data from all three math cohorts), case study notes, and ethnographic findings.

Initial Tests: Randomization (August – October)

I began randomly grouping students on the first day of school, and I haven't changed my primary grouping structure since then: on the first day of the week, students choose a playing card that determines their table of three or four people. Only once during the first week of school after winter break when we had a two-day week followed by a four-day week, have I kept students at the same table across a weekend, and students were visibly perturbed, several asking me why they couldn't change tables. It's amazing how a routine settles in, even if students roll their eyes every time they see the cards.

Along with visible random grouping, I committed the first two weeks of school to non-traditional math content, focusing on tasks to promote discussion and highlight problem-solving strategies. I had spent hours attaching large melamine tile boards (improvised white boards) to my classroom walls before school began, and I tried to get teams up to their boards daily if possible. At this point, teams shared one white board marker, with the (inconsistently executed) expectation that they take turns and that one student would focus on writing what the other team members were saying.

My first goal around teams was quantity. How much could I get teams up and talking together? I wanted to continue with the discourse assessment that I began using the previous year, which I now modified into student friendlier language. In order to streamline feedback and make it visible to students, I used Class Dojo (https://www.classdojo.com/), a point-tracking system for reinforcing positive behaviors and disincentivizing unproductive behaviors. Fairly early on, I became disenchanted with this tracking system and noted this in my first teacher journal entry of the year. The tension between balancing discourse and mathematical feedback resurfaces in a

later iteration, but at this time, I was primarily concerned with how useful the feedback actually was to students.

The day before midterm exams in October, students in all my math classes took an anonymous online survey where they gave me feedback on their experiences working in small groups. Out of 57 responses to the question "What is something that is working for you in math class?" one-third of responses were related to groups, while the next top themes were offered much less frequently. Only 5% of the responses to the question "What is a piece of constructive feedback that you have for Ms. Carter?" related to groups.

> *Student "N" had another "I love test days" moment. When I gave the 5-minute warning for collecting tests, she said that it seemed like class had only been 10 minutes long. When I pointed out that she said that last time too, she said that yesterday (our review game day) went quickly too. She said I should either make it all talking or all silent, because both go by quickly. Interesting… the less it feels cut up by full-group talking, the faster she thinks it goes…*
> *- Teacher journal entry*

It seemed significant to me that the positive feedback was overwhelmingly related to working in groups, while the negative feedback was about time, grade expectations, and workload, and much less about the groups. It felt like confirmation that students find the groups to be helpful and enjoyable. This backed up the anecdotal information that I had collected during class time, when various students would comment that class time had gone by quickly (something I generally count to be a good sign) on days where they were working with their teams a lot.

Diving more deeply into what was and wasn't working for students, I examined their responses to the questions "What is something that you like about working in teams?" (Pros) and "What is something that you would like to see changed about working in teams?" (Cons). Five themes emerged: support, relationships, autonomy, identity, and "on-taskness." Within each of these themes I counted how often the comments were positive or negative. Overall, of the 122 comments, three-fifths were gave positive feedback and two-fifths were negative about group experiences up to that point. These numbers are summarized in Table 1 and discussed below.

Table 1
Summary of Frequency of Comments within Each Theme.

	Themes					
	Support	Relationships	Autonomy	Identity	On-Taskness	Total
Pros	37	16	3	17	1	74
Cons	3	13	19	2	11	48
Total	40	29	22	19	12	122

Support. Support consisted of giving and receiving help in the group in order to improve work accuracy, quality, and understanding, as well as group accountability. The vast majority of comments were positive.

> *I can connect and share my ideas with others and they can help me out if I'm not understanding something or I miss something that I am struggling with. Also I can give them feedback and help them with things they may not be completely sure about*. (pro)

> *One thing I would change is that we have to be responsible on how a team member acts because it depends on our grade* (con)

Relationships. The second theme, relationships, reflected opinions that were fairly split between negative and positive. Students appreciated the opportunity to learn more about and with peers, but also acknowledged how relationship issues can make group work harder.

> *I get to learn about my classmates.* (pro)

> *One thing I would like to see change is that people don't make a big fuss about who they are sitting by and get a big attitude.* (con)

Autonomy. The majority of these comments were negative, with students expressing concerns about their ability to work independently with their teams and to have a choice in the makeup of their teams

> *Something that I like about working in teams is you have people that are smart and can help and it's time for you to ask or get help instead of always asking the teacher or always being confused.* (pro)

> *If we don't like the people we with can we switch out.* (con)

Identity. Identity emerged as a theme in students' comments about themselves as mathematicians who have agency in their teams. The majority of comments on identity were positive; one of the few that was not wasn't so much a negative comment as it was a suggestion for improvement.

> *We're able to discuss our answers and tell how we got them. If we have the wrong answer then they won't make fun of you.* (pro)

> *When done working on board with team do a gallery walk to see other tables' ideas.* (con... a suggestion)

On-Taskness. Lastly, on-taskness, as a theme, was reflected in thoughts students had about their own and peers' time on (and off) task and the effects of this on their group experience. All but one of these comments was negative feedback about the on-taskness of their groups.

> *That everybody is ready to talk to u.* (pro)

Something I would like to see change is being off topic and playing around. (con)

I was immediately struck by the lack of symmetry in the feedback. Other than student experiences with relationships in teams, my dominant themes flipped. Students seemed to experience collaborative learning positively primarily because it provided them with additional support and allowed them to identify as mathematicians. It was heartening to see that students saw support from their peers, because in the past I have gotten pushback from students who prefer support from the teacher to support from peers. This year, the opportunity to get help from teammates with different ideas and to catch errors before sharing or being held accountable were the most mentioned elements of group work overall. Additionally, students shared that they liked having opportunities to share their ideas, which I saw as students identifying themselves as agents of knowledge—mathematicians who had something to bring to the class space and to their teams. While both of these spoke to autonomy in the sense that students were guiding the support they gave to each other, they didn't necessarily speak to students independently making choices for themselves.

Conversely, autonomy and on-taskness were the primary concerns with group work. In particular, eleven students expressed that they disliked random grouping, both for relational and for on-task reasons, and this was the largest requested change for groupwork. Students didn't agree on possible alternatives: some requested that they get to choose their own seats (autonomy) while others requested that I group them in ways that would help their teams work together and stay focused (relationships and on-taskness). They also didn't agree on how long they should be grouped, though this seemed to be less of a focus: one student requested less time in groups (one to two days rather than a week), while another student asked to stay in the same group for two weeks at a time. I recognize that students feel nervous about getting a group that they're afraid won't work together, particularly when they feel like nobody is making a conscious choice to put them in that group. I saw this every Monday when I held out my deck of cards to students and some students hung back as long as possible, while others tried to sneak a look at the cards.

Chuck, upon coming up to the cards: "Ugh, this is the worst part of my week." I told him his weeks must not be very bad.
- Teacher journal entry

I think the students' concern is less about random grouping itself and more about students feeling both that group success is out of their control and that they aren't equipped to work productively with everybody in their cohort. As one student responded, "Well, although there have been some good times there have also been some bad times, and I think that if you are at a table with trouble-makers you get branded as one." What was I doing to train students to work through those "bad times" so they didn't feel like they were stuck in an untenable situation? I wasn't going to discard random grouping, because I wanted to see its impact over the course of an entire year, so it was clear other supports were needed.

One student, a complex instructor in the making, suggested team roles:

> *Something that I would like to be changed when working in groups would be to try having jobs for people like the facilitator, if someone needs a paper one person can get it instead of multiple people getting up for one thing.*

Other students said that they didn't want students talking over each other, arguing with each other, or sitting back and "slacking" while others were working. Up until this point, much of my team instruction had been assessment-based rather than feedback-based. I had "Squad Goals" (see Appendix) hat students reflected on each week, and I used various point-based systems to tell teams whether they were on task, working equitably, and moving forward with problems. Student feedback made it clear that simply assessing students and giving or taking points away wasn't helping them feel more successful in their "bad times," which makes sense, because then they were just watching their team lose more and more points in a vicious downward spiral. This doesn't build the relational trust I need to develop among students if my classroom is going to be a place of relational equity.

Table 2
Summary of Case Study Students Thus Far

Case Study Check-In
Jason
I'm fascinated by Jason's mathematical participation from the beginning, because I have prior experience with him during his two years as a sixth grader. I sense that his emotions run deep and his quietness is a defensive facade. I ask, "How can I get Jason more excited?" in an early teacher journal entry and then note his quietness several times in later entries, while highlighting his mathematical successes, such as on a card sort with Darwin. At one point, students are writing at their board, and I say that every team should have drawn a table. Jason draws a table...literally, a kitchen table. After the last week of October, I write in my journal, "At one point when everyone was present, the team was stalled and I came over. Anna and Patrick said that Jason wasn't sharing. Their way of getting him to share was saying, 'Share!' Anna gave a little more encouragement by saying they wanted to hear what Jason had done. Jason smiled, almost like this was a game--how much could he not talk." At the same time, in my earliest (October 13) record of "Something I'm proud of from this week," Jason writes, "I helped Jamie and Daliah understand something they didn't get." It seems that he has one view of himself and a different view of how he fits in the class ecosystem.

Table 2 *continued*

Darwin	I begin to notice how Darwin responds to his peers and his position in his class. While sometimes my reflections center on his progress from last year (such as my September 30 comment around his mathematical maturity, including, "His work has become somewhat more organized than last year, but he still leaves a lot to the imagination when putting his thinking on paper"), I am most struck by his words. Most notable is his response to a student with high status (arguably the highest status, given everyone talking about her 4.0 GPA like she's a mythical creature) during a group discussion in late October. He asks Alice to explain what she did, then after she does, he says, "Stop correcting me." It's like he has built a defensive wall: he's smart and doesn't need other people just because he is in seventh grade again. This reflects in off-taskness that I note in my journal.
Anna	Most of my entries about Anna focus on my concerns about her engagement. From September 15: "I'm still struggling to engage Anna in positive ways. Yesterday, I told her that she would get a zero for her homework because she was writing in pencil during HW revision time. She said she didn't care. Today, I found myself telling her team to talk on task a lot, and they said they were but stopped when I came up. I'm not sure if that's true or if they were off task before I joined, but it's concerning in either case. Anna's teammate Daliah wrote in her weekly team reflection that Anna had correct answers but wasn't able to explain why. What does Anna need so she will participate more fully in her group discussions? I think it may be relational with me." I write about one instance later in the month where Anna volunteers a whole-group strategy, because it feels like a win to me. I begin focusing on relationship-building with Anna, such as having an impromptu lunch date with her. On October 10, I write, "Anna said that she was confused, very close to the end of class. I want to focus on how to get her group time to be more useful for her."
Sam	I often refer to Sam with her other teammates in my entries, as the "and" in a list of names. The first time that I write about her mathematical contribution is October 10, commenting, "Sam shared first, and she doesn't often raise her hand. I should keep an eye on how often she volunteers." This leads me to begin tracking full-group contributions for a while, and over the course of three weeks I see that she shares once each week. I notice that she is more active in smaller groups, writing after the last week of October, "Elias and Sam took time to work individually, but they always got something on the board and discussed with each other what was going on the board." I feel like I know her the least, even though we seem to have good hallway rapport.

During this first quarter I can summarize my learning in the following ways:

- Students want to feel independent and learn from each other, but they feel disequilibrium and distress when they aren't supported in problem-solving around team dysfunction.
- Students desire autonomy unless they think it's messing up their grade.
- More explicit instruction and proactive structures were needed.

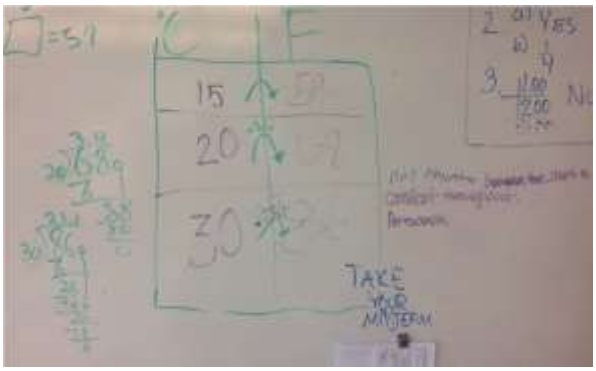
First Iteration: Scaffolding (November-January)

It was time to iterate. Of course, I am simplifying my process, because in truth I was making tiny changes here and there from day to day. But I recognized the need for a shift in how I directly supported students in their team participation, particularly around team challenges. When teams were working smoothly, I didn't see the need for more formal structures, but as the student who suggested group roles seemed to know, more structures would help teams in dysfunction. At this point, I began researching complex instruction tenets more thoroughly, as well as reaching out to thought partners in person and on Twitter.

Three changes stand out during this period:

Individual Accountability. In October, I shifted my one-marker-per-team policy to a one-to-one policy, which allowed me to see whose thinking got on the board and gave me a way to talk to students about their contributions (specifically the quantity of their contributions, although I also often reminded students that just drawing the lines for a data table didn't count as mathematical thinking).

Teamwork Metacognition. Around the same time, I began routine Friday discussion reflections. I asked students to rate their team participation, give their teammates feedback, describe something awesome that a teammate did, and tell me something they were proud of. My hope was to increase individuals' feelings of positivity about their contributions while asking them to reflect honestly on how they contributed to their group.



Using individual markers to track student contributions, I look for visual records of equitable discussion, or whether one or two students did the heavy lifting.

Team Responsibility. Mid-November, I introduced team roles (see Appendix), assigned at the beginning of the week and discussed during their weekly discourse reflections.

I soon realized that student self-reporting was more a record of student self-perception than a reliable indicator of team equity. Just as relational elements were the highlight of my midterm survey, they often shaped student perceptions of their week with their team as well, as students described who was "nice," "mean," "working well," or "playing too much." I wanted a clearer snapshot of student discussion and how students dealt with disagreement and confusion, those

key moments where discussion is particularly powerful for changing student thinking. I wanted to record moments where students felt the urgency to convince each other most strongly, because I thought that would give me the clearest picture of student discourse when (hopefully) all students felt accountable to the discussion.

As such, I chose to video record portions of test days. During the first semester, the format remained the same: the first stage required students to work independently on a test for thirty minutes, while the second stage put the same test in front of students to discuss with their teams and turn in for a group grade. As students tested, I recorded one-minute videos of team discussions. While these short segments can't capture all the nuances of twenty to thirty minutes of teamwork, they were nonetheless revealing.

I looked for the kinds of discourse moves that I want to see students using, and I counted the language (verbal and nonverbal) that I saw students using during the one-minute samples. The data below was collected during in December, one month into first-iteration strategy implementation, and one month later.

Examining student language use quantitatively, it looks like there was a noteworthy change in how often teammates interacted with each other's thinking. Questioning instances increased threefold and disagreeing instances increased sixteen-fold. I had been concerned about the unidirectional transfer of information during many of the December conversations. Explanation was followed by silence during which all students wrote the one student's explanation down. In January (and since then), I have encouraged disagreement by telling students to simply write their answer if they agreed and focus on the places where they disagreed. It appears that focusing students on areas of disagreement may have affected the types of conversation that predominated.

Table 3
Discourse Moves Noted during One-Minute Recordings of Group Tests

	Explaining	Question	Disagreeing	Listening	Repeating	Adding On	Redirecting
December	13	5	1	9	6	1	0
January	18	15	16	7	5	4	2
Total	31	17	17	16	11	5	2

I was troubled by specific interactions that I observed between students in December; specifically, a pattern in who was positioned as an expert. Across groups, whether they seemed more or less equitable in terms of sharing discussion, the student with the lowest grade academic status (and lowest grade) took on the role of questioner, the student with the highest academic status (and highest grade) was the explainer, and the intermediate student attempted to add ideas but was generally not heard. In the most extreme examples, the student with highest status (and grade) did all of the talking and experienced no pushback or questions from her teammates. In one sample video, one team member persistently attempts to share his questions and desire for clarification with his teammates, and they consistently shut him down. During this time, he reaches out to his teammates six times and never gets a clarifying response in return. I was

deeply unsettled by the possibility that some students' contributions had been so devalued that their confusion was considered a non-issue.

Around the same time, students exhibited overwhelmingly positive reactions to the opportunity to be "experts" in the math classroom. They shared long-term math expert research projects with their peers on the last day of the semester, and they said that they would like more opportunities to teach their peers. I began wondering if I could thoughtfully pose students as the experts more often, in order to increase the status of less valued students, and this prompted me to consider a net set of explicit teaching moves in the classroom.

Per colleague recommendations at the end of this iteration period, I had students examine the "most equitable" transcript from the December video recording. While this gave our class an opportunity to discuss equity in discourse and the types of discussion stems people use, it was probably more revealing to me than to them: Multiple students in every class identified the student who was taking time to clarify her teammates' statements and ask questions as somebody who was "confused." To me, this confirmed my concerns around whose role in a discussion was being valued.

In January discussions, where I explicitly told students to focus on the areas where they disagreed, I found that interactions seemed more multidirectional. There was more back-and-forth between teammates, as evidenced by the increase in disagreeing and questioning language. My most equitable group demonstrated a team's ability to navigate a student's questions in a way that values his disagreement and focused on convincing him. While the student with highest status was still generally posed as the expert, all three agreeing students were collectively working to get their teammate on the same page before moving on.

In summary, during this iteration I learned:

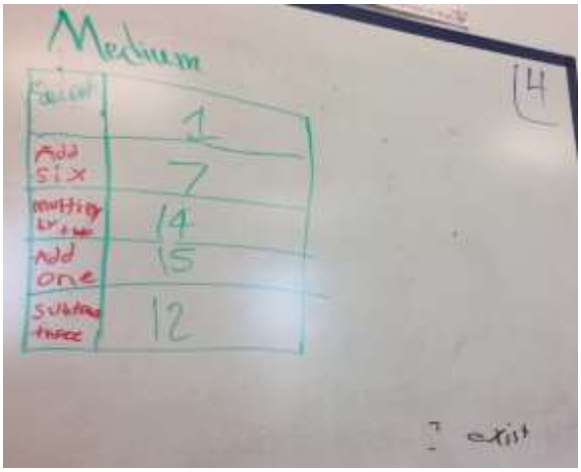
- Students are more likely to spend time trying to convince each other when they're told to focus on their areas of disagreement.
- Students recognize when classmates have changed their thinking.
- They value peer questions less, instead seeing them as confusion.
- Students appreciate feeling like experts.
- Static team roles can value certain group contributions over others, making some people feel that their contributions don't matter.

Table 4
Case Study Check-In After Iteration 1

Case Study Check-In
Jason
I notice an interesting moment during January's video sample: Jason shares his answer to a problem with Daliah, but instead of asking him how he got it, she disagrees, verbally solves the entire problem while Jason and Patrick wait, and then asks if they agree with the same answer that Jason proposed in the first place. Not long after this I met with Jason and his father at report card pickup and said: "I told Jason that he has some of the most clearly organized mathematical thinking that I have ever seen and that it is a major strength that I'd like him to share more with his groups. I asked why he's often so quiet in math class. He said that he often doesn't talk because people ignore him. He referred to his group from the week before, Darwin and Maddie, where even when he and Darwin had the same work written down, Maddie would talk to Darwin and not to him. I counseled Jason to let his work speak for itself by putting it in the middle of the table to convince people. I said that they would be impressed by his clear reasoning written down, and that would take some of the pressure off of talking." In weekly teamwork reflections, 30% of the feedback from his teammates is to communicate more. Alice, one of the highest status students, recognized that he "understood the material": people realized he knew what he was doing once they actually heard from him. Interestingly, Jason is grouped with Darwin twice during this period, and Darwin writes that he is "talkative" and "always has something to say to the group." I wonder if their recognition of bringing more to the team than the team expects leads them to communicate more with each other.
Darwin
Darwin has begun saying, and writing on his team whiteboard, "I exist." It feels very philosophical, but I think it is a reflection of his frustration that teammates don't see what he can offer. I ask students to reflect on their participation based on their team role; at one point, Darwin writes that his role (Chief Engineer) doesn't matter, a stark contrast to how much people play up the role of the Captain as the leader of the group. His teammates mostly talk about his focus in their team feedback sheets. During this time period, half of the feedback from his teammates is around behavior, such as "Play too much. Stay focused" (a sentiment repeated by another student almost verbatim), "Funny/hilarious," and "Talkative." In contrast, Darwin credits himself with strong mathematical thinking twice in reflections, writing "I moved my group forward with a problem" when asked to describe something awesome that someone did (November 9) and "My thinking has not changed because I thought correctly" when asked to describe a time someone changed his thinking (December 15). I am seeing, even more clearly than earlier in the year, that Darwin recognizes the dynamics at play in the classroom, but that his response (being the wise-cracker or goofball) is not as mature as his awareness.

Table 4 *continued*

Anna
Anna is not being seen as an expert in any mathematical way by her peers. Across ten pieces of feedback from teammates, all refer to her needing to ask for help, fix her mistakes, be more active, or communicate more. While these are important skills for a mathematician, they don't position her as someone who helped change other people's thinking. This is troubling, because I think it reinforces Anna's self-concept. She said she was proud for "Getting my work done" in one reflection (December 8), crediting herself for completion rather than quality, and she talks about being "slow." A powerful moment is when she shared her math expert project on modular origami, because it is the first time all year that I have observed her taking the floor as the expert about an idea. I make sure to put her poster on the wall.
Sam
Thus begins the saga of Sam and the "'tude." Every week, almost without fail, Sam's "proud" moment is that she has, in some way, controlled her attitude or her meanness. This fascinates me, because I don't consider her to have issues with either of these things. It makes me wonder what dynamics are at play in groups that are causing her to be proud of keeping her attitude in check. Jonathan gives me some insight on December 1 when he writes, "She was getting angry at people but she was also a good helper." From Sam's verbal and body language, and it appears that she takes a passive role in the actual math activities, but more of a guiding role around the social dynamics of the group. She doesn't offer mathematical ideas to the group, instead asking clarification questions about directions or what people said, and she records thinking on the board that other people tell her to write. At the same time, she asks a student who isn't participating with the group, "Edwin did you get something down or are you doing your own?" While she seems less confident about the math, she finds ways to contribute. I would like her to be seen more as a math expert, but, as Patrick writes in November feedback, "Sam kept us moving because she had saw us slowing down a lot or the time she was the main person that kept us moving." I realize that I haven't been seeing how she is involved in groups, because I've been more concerned about her math contributions and understandings. Both are important, however; she still exhibits confusion in many written assignments, making me concerned that team time hasn't changed her thinking.



Nothing makes a teacher feel urgency around equity like a student writing "I exist" next to their teammates' work.

Second Iteration: Flexibility (February – March)

Assessing the potential impact of my first-iteration small-group discussion strategies, it appeared that students were examining their roles (formal and otherwise) in their teams, and finding ways to be more involved in their teams, whether mathematically or structurally, but valuing certain contributions and roles more highly than others, which could reinforce status hierarchies.

I decided to focus on these points in my second-iteration discussion strategies, which aimed to provide more flexible and explicit opportunities for students to take on leadership roles in their groups and see value in peers' contributions. In order from highest to lowest frequency in implementation:

Flexible team roles. I discarded weekly team roles for a more flexible structure, labeling each seat at the tables with a different color and using that to assign team roles, sometimes in advance (such as having four different tasks as part of a group task) and sometimes ad hoc when I realized I wanted to increase someone's team participation and status. For example, if I wanted to make sure Anna had something to bring to her group and was seated in a green spot, I could call a "huddle" (a complex instruction tool) of all the "greens" and give her a piece of information to take back to her group.

More explicit reference to team boards. At this point, we had moved to a new building and I had installed new whiteboards for team use. It was easier for people to see everyone's boards, and I began pausing students more and drawing their attention to the boards, particularly for mid-work progress checks. I looked for teams that included people who hadn't shared recently so I could highlight their intellectual contributions.

More targeted discourse reflections. My weekly discourse reflections evolved to the format available in the Appendix and I focused on a task that I had introduced at the beginning of the year: "Describe a specific time when somebody changed your thinking." Since it was in the teamwork reflection, students generally assumed that they needed to consider their teammates. If they couldn't think of a teammate, I instructed them to think of somebody because unless they got everything perfect that entire week, somebody or something should have changed their thinking. I did this so students would more carefully consider the ways that they were mathematically learning from their teammates.

Assigning public "expertise." Following the generally positive response to being "experts" with their math research projects, I orchestrated a few review sessions where students could opt in to small groups led by students who had shown proficiency with a certain skill. I looked for students who were less publicly recognized by their peers as "smart" but who had showed proficiency. Darwin and Jason were both "experts" at different points.

I noticed that students adjusted quickly to having a clearly assigned expectation of what they were supposed to do, although some students resisted giving up roles that they wanted. My favorite was Patrick, who said, when I told him he couldn't be in charge of the laptop on a particular day, "But I want to take control!"

Recognizing (Belatedly) the Importance of Class Culture

At the same time, I observed an uptick (perhaps because I was listening more) to certain language being used in my focus class. "I'm not that smart" became a popular refrain, led first by a student with a high academic status (originally in the "gifted" program) and then parroted by other students, including a diverse learner. I also found myself responding to labels of "slow" and "retarded" (both self- and other-directed) more than in the past. Toward the end of February, one "gifted" program student wrote, "I am proud of knowing more than my team." Red flag! During this time, I shifted my data collection focus primarily to my case study students, and this led to what was probably my most important insight into this class's culture.

On March 8, I observed a team working on newly discussed algebraic ideas. The team included both Anna and Sam, as well as Jonathan, a student who had been retained in sixth grade, and Carl, the high-status student who started the "I'm not that smart" trend. I observed deep discourse dysfunction, where teammates spent most of their time working (or sitting) silently, punctuated by off-task conversation between Jonathan and Anna, and Jonathan and Carl exhibiting odd behavior where they simply stared at each other. Afterward, I reflected on how this table dynamic felt very different from a later class that day, where students were cheering each other on in little ways as they worked, even commenting that they were proud to be in a group with their other teammates. What was stalling this particular group from making the progress I was seeing elsewhere?

If somebody thinks one thing and you think another thing and that person doesn't want to change their thinking, it's going to be hard to work in that group.
- Quote from Darwin

On March 9, I conducted an interview with Darwin about his experience working with teams, and he made explicit what I had been tiptoeing around for months. Asked about his experience working in teams this year, he was primarily negative in comparing it to last year: "If somebody says the wrong answer, somebody's going to bring them down or say something." He said that "disagreeing with somebody that's stubborn" is challenging. He identified "positivity" as the key to "good team chemistry" and used a recent competitive game-based activity as an example of his team having good positivity. When I ended by asking whether he had anything else he wanted to share, he quickly jumped at the opportunity: "Yes, I feel like the students in this class in particular should be more positive [...] I feel like how Carl is, he's always bringing people down, but I feel like he should be more positive and actually help people. I mean, he does that sometimes, but not all the time." I asked him if there are classes where he sees people being more positive toward each other, and he said no: "First, I want to say that they don't really change their behavior in any class, but in some places they do get a little bit more aggressive, like in gym 'cuz they think everything is a competition." Interesting that he thought his teams were most positive in math in a competitive game setting, while he related competition to increased aggression. He seemed to see team spirit as the product of teams banding together to compete against other teams. We know the power of a common enemy!

He left me reeling. How could I have so totally overlooked this culture issue, when I thought I was focused on teamwork every day? I was treating discourse as something to be taught through

roles and reflections, without paying enough attention to the ways people were treating each other as humans. I left school with a new resolution.

Table 4
Case Study Check-In After Iteration 2

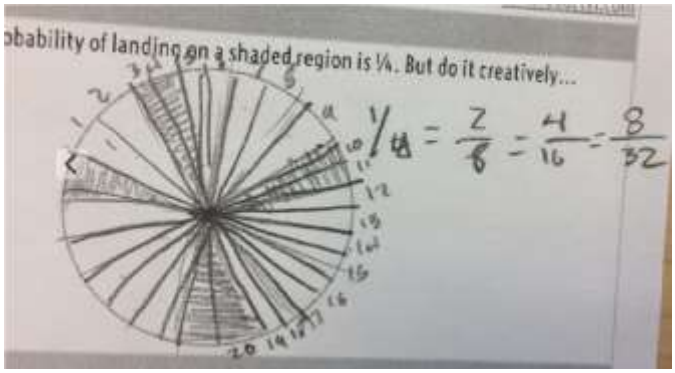
Case Study Check-In
Jason
Four people say that Jason changed their thinking during their weekly discourse reflections, though they continue to ask him to "Speak up" and "Talk more." During a February 26 interview, Jason tells me, "There are good things that can happen in teams and bad things, and, like, throughout all my year with teams, they've been good because you have a chance to communicate and, like, work in groups." I find it unsurprising that he cites getting frustrated "when someone doesn't listen to you [him]," and I'm impressed that he talks about triangulating communication by asking the person who will talk to him to communicate with the person who won't. Still, this shouldn't be an issue at all and speaks to a problem in whose voices are valued.
Darwin
Four people also say that Darwin changed their thinking. However, I described continuing status issues: "When I named my "experts," [...] there was general noise of disbelief when I got to Darwin. He responded with his usual vigor, with something like, 'See!?' And Daliah said other people were being disrespectful (which felt kind of rich, since she said something about him last time he was an expert)" (February 12). He identifies his classmates as being off-task while saying that his focus in class has improved from last year: "yesterday, I was almost on task for the entire day in math, but compared to last year, I wasn't doing anything last year" (March 9 interview). Other students are still giving him feedback to "Stop acting goofy," but it is at a lower proportion to other comments than in the previous months. It's heartening that he sees himself engaging differently (and I agree), while it's frustrating that he doesn't think peers see what he has to offer.
Anna
Once again, nobody says that Anna changed their thinking, although she said that she engaged more in her teams for three weeks in a row. Conversely, people mention lack of focus in about 30% of her team feedback comments. Recognizing that focus is one of her challenges, what needs to change so she can be more successful in her groups?
Sam
Three people say that Sam changed their thinking, including one of the highest-status students. She continues to talk about her "meanness" and "attitude" being better. In the midst of team dysfunction, I see her taking ownership over her work (accurately solving number tricks without her team's support), but it doesn't often translate to her performance on formal assessments.

By the end of the second iteration, I had learned some uncomfortable truths.

- Meanness runs deep in my focus class's community, taking shape in a negativity with which students respond to each other.
- For children who are just learning to navigate sarcasm, it is clear that they are testing it out on each other in ways that are counterproductive to building relational trust and thus relational equity.
- This problem appears to be both rooted in and perpetuating toxic status issues. I believe that students expect to be put down, and respond defensively in order to feel ownership over their image.

Third Iteration: Positivity (March – April)

So here we were, three-quarters through the school year, and I finally realized something that most elementary teachers probably would have considered in the first week of school: Is a group of students that spends all day together nice to each other? And, with standardized testing creeping ever closer, how do I address this issue without "losing" instructional time?



Taking and immediately displaying pictures of student work remains one of my favorite ways of assigning competence as students construct concepts.

For about a week after Darwin's interview, I ended each lesson with the opportunity for shout-outs. Some students seemed to enjoy volunteering team shout-outs, but I wanted strategies that would directly tie mathematical contributions with positive group interactions. The first three strategies that follow are team-oriented, while the fourth was an attempt to deemphasize signifiers of "smartness":

Leading with group tasks. A fellow math teacher told me about Get It Together (Erickson, 1989), a book of group tasks that promote equitable problem-solving by giving each team member necessary but insufficient information to solve the problem. I began using these tasks as entrance routines on Mondays, after students joined their randomly assigned teams. I hoped it would get them talking to their team immediately and feeling success about the ways they were working together.

Assigning competence through picture. Mid-March, I signed up for a Flickr photo-sharing account after observing its utility in an adult math course. I saw that immediate photo-sharing drew teammates' attention to the person whose work I was photographing and let me explicitly show whose work was helping our class learn. Just like with boardwork, I looked for students with lower status, but this method gave me more agility and let me highlight individual contributions. As I write this, I have ninety-five student work pictures posted.

Tracking accountable interactions. Wanting to signal to students that I am always listening and give them more frequent feedback (rather than scores) on discussion moves, I returned to the online discourse tracker (ClassDojo) that I had sporadically used the previous year. My feedback for individual teams was displayed in chronological order, letting them see in real time what I wanted to coach them on. It required me to step back, listen, and give frequent feedback, rather than simply a score for a positive behavior. In the first week, I used it twice to get students used to the tool; thereafter, I used it once weekly, hoping they wouldn't become dependent on my feedback. I pushed myself to highlight positive behavior and words, but it also allowed me to give constructive criticism without loudly calling teams out.

Losing the score. I stopped putting numerical scores on my daily formative assessments, instead only giving written feedback. I noticed that students had become focused on the number and were comparing it as soon as they entered the classroom, since I stood at the door and returned the previous day's sheet as they entered. I wondered if losing the score would prevent students from immediately feeling their status upon entering the space.

I have less data about the possible impact of these strategies, but some themes were present. Maddie, a student in my focus class who often wants teacher approval about her work, complained in March, "Why don't you teach us anymore? You make us work in groups all the time!" The next week, she told me that she can't learn from groups, though later in the period as she was working with a high-performing student, she said they were working well together. I think that students have received the message that they are responsible to learn from groups, but they still don't feel like they can work with everybody. Still, I have noticed that the energy in the room on Mondays feels more comfortable, as students come in and immediately start talking about the group task with their teams.

Donte', one of my diverse learners, encouraged me to take a picture of his work recently (late April) and reminded me that I hadn't taken a picture of his work yet. Students notice and want the recognition. The most powerful outcome from pictures for assigning competence occurred outside of my focus class, but I think it's indicative of the benefits of pictures. Students were working on calculating the area of a triangle on a grid, and Sara decided to box the triangle in. I took a picture and posted it, saying, "Look what Sara did! How might this help?" Two days later, students were still publicly referring to Sara's method, which brought a smile to the face of a student who generally has some of the lowest status and mathematical self-esteem in her cohort.

I have found that my discussion tracker appears to be most effective when I don't need to step in to work with students on the math itself. When I use it on a task where I want teams to be close to completely self-reliant, I can wander and write, and this is when I'm able to give the most positive feedback and gentle nudges on team moves, often reminding students to write their thinking down so they can convince each other. I gave the least feedback (one comment per team in a period of twenty minutes) during a session when I had to step in mathematically, while I gave the most feedback (on average four comments per team in a period of ten minutes) during an activity where students worked independent of me. I didn't say they couldn't ask me questions, but because it was a "competition" (Darwin reminded me that competitions can serve a team bonding purpose) they seemed to assume that they shouldn't talk to me. Instead of asking me questions about the math problems, people sporadically asked me questions about my

comments, which let me coach them on their terms. On the most recent tracker for my focus class, half of the comments are positive reinforcement, while most of the rest are suggestions about how to convince each other (for example, "Can you convince each other using writing/drawing?") or pointing out places where equity needed to improve ("Make sure everyone has access to the problem" and "Consensus before clicking!"). This contrasts with my first tracker with this group, where only 19% of the comments were positive.

Table 5
Case Study Check-In After Iteration 3

Case Study Check-In
Jason
Within three weeks of discourse reflections, three people credit Jason with changing their thinking. He says he is proud of "how much work my team did" and "My team's ability to communicate."
Darwin
During the same amount of time, five people credit Darwin with changing their thinking. He also receives compliments such as "Worked hard," "He help me," and "Engage a lot." He still says "I exist," but I don't hear it as often.
Anna
Anna has reached a place of frustration. She is currently failing all four of her core academic classes and has said (in jest?) at least twice to me that "she's going to drop out," and this exploded in class on April 13 when she repeatedly called herself retarded, even while walking across the room when I told her to step out. Recalling the discussion the next day, "I asked her why she was saying she's retarded. She said it's because she's slow. I asked her to tell me what she means by that, and she said she's dumb, that she doesn't get things quickly like other people do." At this point, nobody has yet said that she changed their thinking in a weekly discourse reflection. Still, when interviewed about her experience in teams, Anna says that she appreciates getting support from her classmates. While she is not positioning herself as a creator of knowledge, she acknowledges that "problems have been getting easier."
Sam
Sam's mother has reached out about the fact that Sam is afraid to ask questions more than once in all of her classes, and this is causing her to fall further behind (spending much of second semester with a high F in Math, and passing in the end). I have been slowly coaxing Sam to come work with me during lunches, without saying "You're failing and need help." She has been coming to lunch more, with one of her buddies, but she often works on her design projects instead of math.

In summary of the third iteration, I gained insight into the fact that:

- Students who feel like their groups move too quickly or don't help them enough become frustrated because they feel lost and they can't keep up.
- Photographs provide students with proof that their thoughts matter.

- Students who are used to low scores seem to become more positive about their feedback when there isn't a score attached, while students who are used to high scores feel off-balance when they don't receive a status signifier from the teacher.

The State of Status in My Classroom (May)

> *Why don't you teach us anymore? You always make us work in groups all the time.*
> *- Student comment noted in teacher journal*

Nine months into random grouping, it was time to see what students thought. First I wanted to see if students actually felt like they had become better team members over the school year. Of fifty-two students who took the second, end-of-year survey in April, about 84% self-identified as having grown within that time. Perhaps students wanted to make themselves look good, but it still suggests improvement in their self-concepts.

Pros and Cons of Group Work – Students' Point of View. I revised my questions from October in order to more explicitly get a "pro" and a "con" piece of feedback from students. I asked, "What's been your favorite part about working in teams this year?" followed by "What's been your LEAST favorite part about working in teams this year?"

I used the same thematic codes that had emerged from the first survey: support, relationships, autonomy, identity, and "on-taskness. Table 6 shows the frequency of responses within each code and a representative comment.

The two "con" comments for relationships and autonomy below were the only two responses that explicitly referenced random grouping, perhaps because I didn't ask students what they would like to change, as I did in the first survey. It feels important that relationships were referenced more frequently in April (46 times) than in October (29 times). To me, this highlights the importance of positive relationship-building throughout the year, in order to reduce the disparities in student status and to improve relational trust in general. It is notable, although not necessarily surprising, that there were approximately the same number of pro and con statements about relationships. Both comments indicate students being more thoughtful about the relationships they have with their classmates. There were fewer comments on autonomy, only seven compared to 22 before. This could reflect teamwork being less novel at this point in the year.

Table 6
Frequency of Responses for Each Theme and Representative Responses - April

Themes	*f*	Response Examples
Relationships		
Pros	22	Being able to talk about math with my friends
Cons	24	My least favorite part is that the teams are picked randomly, meaning you might end up with team of people who you don´t work well with.
Support		
Pros	22	Being able to see other people's thinking about the work, and them being able to change my point of view of a certain math problem.
Cons	11	Some people don't know what they're doing, so if I need help I won't get the right help.
Identity		
Pros	17	I get to build off of my understanding to challenge myself.
Cons	3	Some people take credit of what you gave out to your team.
Autonomy		
Pros	2	Being able to ask your team for help before asking the teacher.
Cons	5	That we have to pick a card to pick who we sit by for the week and sometimes we do not get to sit by the people that we want to sit by, but most of the times it is not that bad.
On-Taskness		
Pros	1	You can always communicate with your team if you need them [...] it makes it easier to do you work and get things done faster.
Cons	12	People would get off task and talk a lot and get the entire table in trouble.

Reasons for Random Grouping – Students' Point of View. I also asked students why they thought I randomly grouped them. Two students said they didn't know why and two students brought up fairness. Three students, all from my focus class, nailed my purpose:

> *So that nobody feel any lesser than another person as if saying someone feels dumb.*
>
> *You said that you pick them randomly so that nobody feels that they are the dumb person in the group.*

> *So people won't think that you are picking on them and you won't people to work with different mindsets.*

Most of the other ideas students had fell into one of three categories—improving focus, working with everybody, and getting other perspectives. Respectively, a quarter of students assumed I had a desire to avoid friend pairings who might talk too much, harking back to the differences between social and educational goals for small-group work; 60% believed the reason was to learn to be able to work or get along with everybody, either now or in the future; and 15% cited my desire for students to get different perspectives.

Arguably, these three points are the reasons that I did everything I did after initially starting with random grouping. In general, students identified my goals for discussion, even if they didn't recognize my early desire to release everyone from expectations about student roles in teams and the class ecosystem.

While this survey data was aggregated across my three classes, I dove deeper into my focus class's specific responses around their team participation. I sorted the students into three status groupings based on the last four discourse reflections before the survey. Here, I define "status" as the extent to which a student's peers see them as a source of expertise, knowledge, or support. I have chosen this distinction here, because when students are seen as experts, I think this demonstrates relational equity as Boaler (2006) defined it. My top third of students by status were those who at least five people credited with changing their thinking (Darwin was second in this category!); the middle group was comprised of students who two to four people credited; the bottom group received one or zero change-your-thinking (CYT) credits from peers. Table 7 provides examples of students' perceived change in their status as a math team member, along with a comment.

A pattern emerged in the comments. Students with higher CYT status tended to describe how they improved in their interactions with their teammates and in their ability to be effective leaders. Students in the middle category tended to describe the content of their discussions and their ability to focus. Students who had lower CYT status tended to consider how they learned to speak up more and get support when needed.

As I noted earlier, Anna (the only person who said she definitely did not improve) described her problem as feeling as though she moved more slowly than her group. The other two students who seemed the least positive about their contributions were those students who were generally perceived, by other students and by me, as defining status as "smartness" and "slowness," and who appeared to dislike the team model more than the other students. One of these two students wrote negatively about teams for the entire survey. It appears that these students' attitudes toward peers and teams throughout the year ended up having a significant impact on their self-concept. Both were part of the "gifted" program at the beginning of the year but found their grades across classes were not nearly as high as they had been in sixth grade, and I wonder if this caused them to become defensive and respond with more barbed comments toward their peers.

Table 7
Change Status and Student Comments

Prompt: Explain your answer to whether you think you improved as a math team member this year. (ex: What has made you better? Why do you think you're not better?)

	CYT Status		
Change Status	Top third CYT status	Middle third CYT status	Bottom third CYT status
No change	Tyan: I think I'm the same because nothing really changed, but I think I'm able to tolerate people better than I did before. Jamie: I've always been the same I was always glad to help and work with my teammates even though I don't like them.	Edwin: The system is weird. Carl: Nothing was really that challenging plus I didn't try.	Anna: I don't catch on to learning the lesson fast
Improved as a team member	Darwin: I am better because I can lead my team into the right direction. Jason: We learned new information/topics. Elias: As I got paired with people I didn't know that well, I found way to interact with them. Alice: I think I have gotten better because I´ve been trying hard not to just do all the work and try to ask my team mates questions to help them figure out the answer.	Matt: I'm not talkative as much. Tyler: When I was working with other people more often and getting more work done. Daliah: Something that has made me better is other people helping me understand my work Keenan: I notice a growth in my answer choices and how i answer question	Jonathan: I think working with certain teammates made me better or either made me a better me Maddie: When people convince you to do your work another way because you don't get it has helped me this year. Sam: Me taking the time out to accomplish the things I didn't understand. Patrick: Because at the beginning of the year I was a little shy and didn´t work with people well but now I do a good job with working with my group Jordan: I wouldn't really answer questions that much.

Overall, few students shifted in what I saw as their status in the classroom from the beginning to the end of the year, with the notable exception of Jason and Darwin. However, it seems like most people, regardless of their status, found teamwork to be helpful in some way, albeit differently across status groupings.

Conclusions

I am not deeply satisfied with the progress that my classes made in team discourse this year. Anna feeling "slow" in April and Sam still being afraid to ask questions remain thorns in my side. Students still groan on Mondays when they see the cards, though I think they enjoy the moment of adrenaline too; perhaps I'm creating gamblers. But I hear students describing changing people's thinking and their classmates' methods in ways that give me hope, just as students being surprised at the peers that they can work with makes it clear that random grouping has merit.

My study had limitations. I chose four students to follow who were similar in many ways, because their status in the classroom felt urgent to me. If I had chosen students with higher status as well, perhaps the two students who ended the year with so much negativity, I might have gained deeper insight into some of the culture shifts that still need to happen in my class. I also think that given my context within a cohorted school, it might have been illuminating to observe students in other classes to gain more insight into Darwin's claim that his classmates' behavior doesn't really change across settings. Similarly, I observed anecdotally but didn't collect consistent data on how student behavior changed across task types in my class, and I think that I overlooked the importance of group-worthy and team building tasks to developing team identity, pride, and positivity. Given my final survey data, I would like to further examine how status roles affect the ways that students benefit from teamwork and the challenges they experience in teams. This merits further study in the future.

Regardless, I plan to take these ideas with me as I prepare for a new year with a new group of students to study.

- Random grouping releases student expectations and my own about who should be in teams together, which can have an anti-hierarchical effect but also highlights the urgency of addressing status issues. This is because,
- Status issues run deep, deeper in some groups of students than in others, and they can be exacerbated by individual student contributions, group dynamics, and school structures. This means that,
- Status interventions need to be flexible and constant, while signifiers of status, such as written numerical scores on papers, should be avoided. Instead,
- It's helpful to assign competence within the classroom space in mathematically specific ways so students see the value of their and others' contributions. Also,
- When coaching students on team discourse, it helps to increase proportion of specific and immediate positive to negative feedback, keeping negative feedback private rather than public, while keeping the positive feedback focused on how it helps everyone's mathematical understanding. I want to examine more how

- Certain tasks lend themselves better than others to promoting appreciation of each other's ideas, and how to use diverse task models that still improve student mathematical strategies. At the same time,

Next Steps and Recommendations

There are new steps I recommend for myself, other teachers, and for policy makers. These include recommendations within the math classroom and throughout a school building. My recommendations pertain to grouping, providing feedback, group tasks, and teacher-talk.

In the Math Classroom

Grouping. Based on my experiences, I recommend incorporating frequent and visibly random grouping into daily routines. When it is the norm rather than the exception, students become used to the idea that they have to work with everyone and that they have something to bring to any group. It also relieves the teacher from making grouping decisions based on prior expectations about how students will contribute to their groups.

Group Feedback. Groups should receive frequent feedback around their discourse, particularly about how equitably people are involved in discussions. This reinforces positive group dynamics, troubleshoots problematic group dynamics, and keeps the teacher focused on student interactions. This feedback can be both from the teacher and from teammates, as peer reflections promote metacognition about collaboration.

Individual Feedback. Feedback should be specific and relevant without a numerical or categorical score. It is not necessary to give written scores on daily assignments. Avoiding this whenever possible helps prevent students from comparing themselves to their peers.

Tasks. In math classrooms, we must incorporate group-worthy tasks whenever possible. I suggest *Get It Together*, by Tim Erickson (1989), as a starting point for general group tasks. *Strength in Numbers*, by Ilana Seidel Horn (2013), provides ideas for assessing the group-worthiness of math content tasks so they are integrated throughout the curriculum.

Teacher Talk. Math teachers, among all teachers, should also decentralize teacher talk as much as possible by making student thinking visible to everyone. Two structures that have been helpful (and that I want to explore more) are vertical non-permanent surfaces (enough whiteboards and chalkboards mounted at least for every group) and photo sharing. These methods, when paired with thoughtful choice of student work to highlight, help assign competence to students who enter the classroom with lower status.

In the School

Grouping. I recommend heterogeneous (rather than "ability"-tracked) classrooms where teams within the classroom are randomly grouped. My school already heterogeneously groups students into cohorts; random grouping could be a next step to relieve academic status expectations. I also recommend discontinuing "gifted" programs that elevate some students' status above their peers.

Physical Space. I recommend a table set-up that encourages teams to sit close together and work together (rather than desks that promote individual islands), as well as the installation of student non-permanent work surfaces for groups to discuss their thinking and share it with the class.

Celebration. When the school's celebration of students centers around their GPA, students begin to see themselves as numbers who compare to the numbers around them. While I recognize that this is meant to promote hard work and improvement, it appears to solidify academic status hierarchies. I suggest other, or at least additional, methods for celebrating students, such as providing incentives based on student academic growth (like increases in GPA) rather than a set number (currently a 3.0). I also discourage celebration of students in terms of "excellence" and "grit," because these categories have come to mean mutually exclusive things to students, as they see the same individuals winning "excellence" awards routinely and "grit" awards become consolation prizes. I encourage regularly showcasing student products instead, so everyone can see their and other people's work as valuable.

Failure. I suggest that we engage in a serious study of why some students are consistently failing across multiple classes, as this is incredibly damaging to their academic self-esteem and an obvious signifier of status hierarchies at the school level. I encourage that we consider how we grade students' academic habits and use homework as a marker of student success.
Teacher Collaboration: There is some continuity in discussion structures, instruction strategies, and grading across math classes, but it is limited by the lack of time for teachers to meet and observe each other. I suggest routine math teacher meetings to develop strategies around status interventions, balanced with work on foundational skill development (something that causes status rifts).

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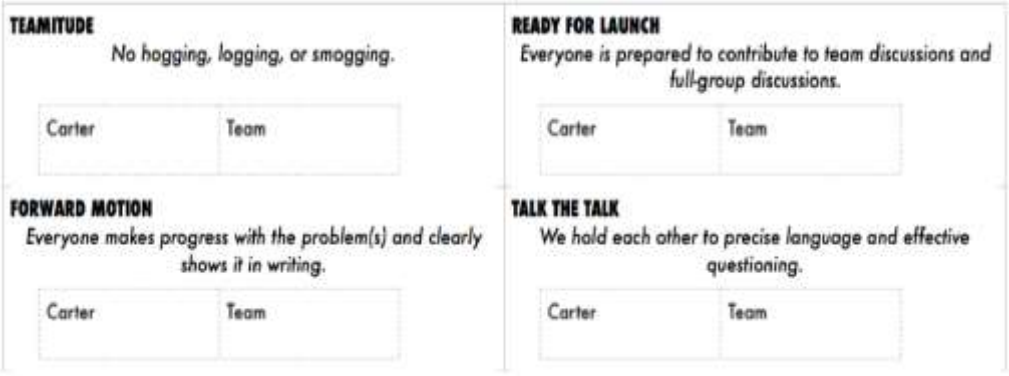
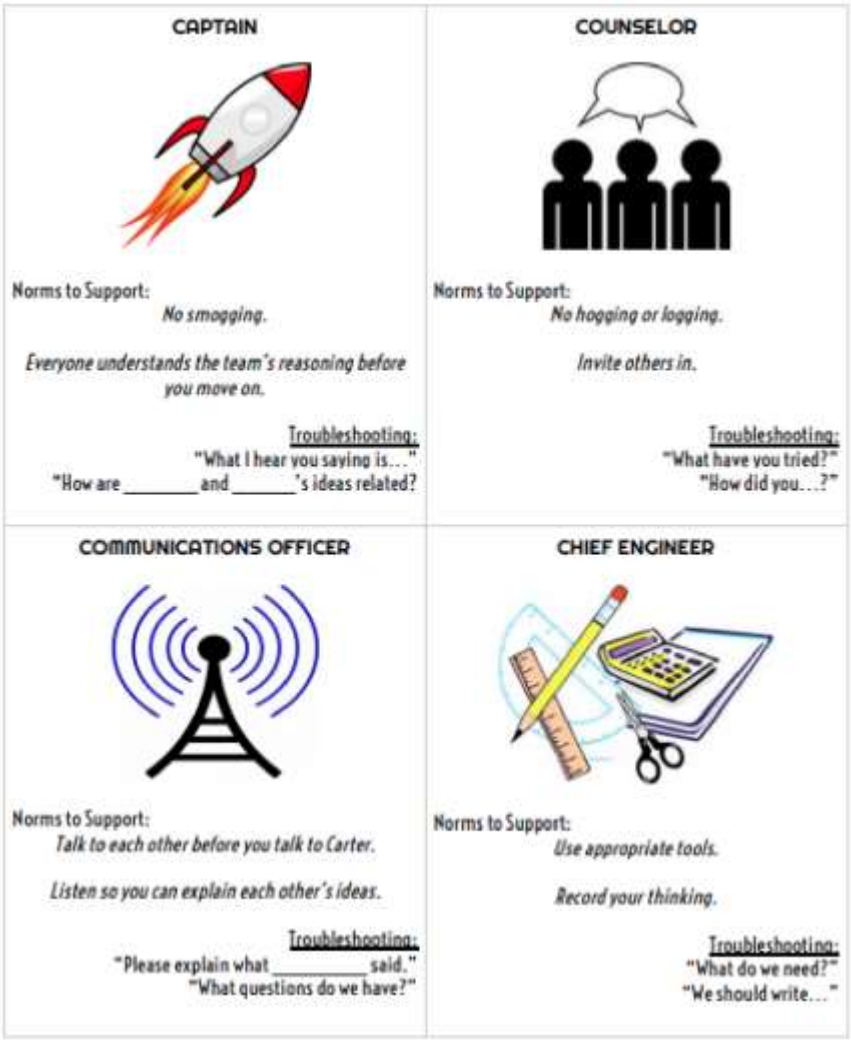
Appendix

Initial Discourse Tracker, created August

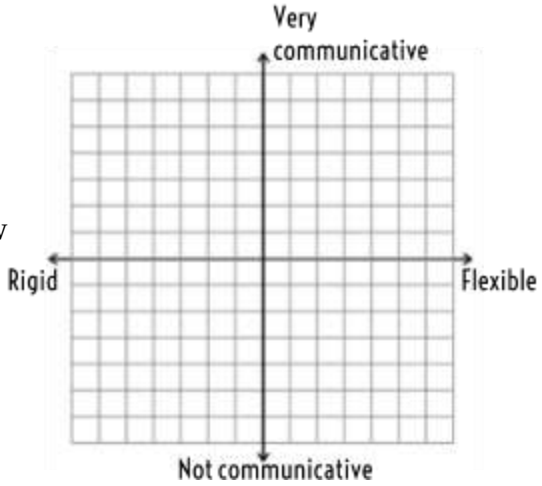


Group Roles Sheet, created November



Discourse Reflection, updated February

Team Math Discourse Reflection



1. For each person in your team, place a point on the plane with their initials by it. This shows where you think they fell this week in terms of their flexibility/rigidness of thinking and how communicative they were.

2. For each person in your team, including you, give one compliment and one push to help them improve their math discourse.

	Compliment	Push
N:		
N:		
N:		
N:		

3. Describe a specific time that someone changed your thinking this week. Tell me what you thought before, what the person said or did (and who the person was), and how this changed your thinking.

4. Tell me something you are proud of from this week. (does NOT have to be about teamwork)