Preface

Originally, all of us were teachers in public schools. Most of us taught in elementary schools, and we struggled to teach math in ways that would enable all our students to build robust understandings of the elementary school math curriculum. Most of our students did well, enjoying the chance to move beyond computation and think about the reasons why the rules they had learned might work. But we were never satisfied that *all* our students were learning well. Some children always seemed to hang back, unable or unwilling to join group investigations, struggling even to begin work on the problems that their classmates were solving. Others did not seem to be challenged enough. So, not surprisingly, when we came to Michigan State University and began working with other teachers and prospective teachers in the certification program, we worried about giving our students the tools they needed to succeed in teaching powerful mathematics to all *their* students, a goal dear to their hearts and to ours.

Then we learned about complex instruction, the insights and strategies that were enabling a scattering of other U. S. elementary and secondary school teachers to address the problems that make it so difficult to engage the full range of children in our classrooms with challenging, important mathematics. Complex instruction seemed to enable teachers—even prospective ones—to engage children who had formerly remained silent and uninvolved during serious mathematical inquiry. Finally we could offer help to teachers who wanted to know how to engage "my low kids."

We address this book to elementary school teachers and interested teacher educators who want to teach serious mathematics to all their students, to challenge children who now finish their work long before their classmates, and to involve more fully children who currently try to remain invisible in math class and show little understanding of the math we try to teach them. The book is about using complex instruction to teach elementary school mathematics. It builds on work that the six authors—Helen Featherstone, Sandra Crespo, Lisa Jilk, Joy Oslund, Amy Parks, and Marcy Wood—did together at Michigan State University to teach teachers and prospective teachers in our elementary school teacher preparation program. We strove to make complex instruction a part of their mathematics teaching practice, with the goal of teaching challenging mathematics conceptually to *all* children in their increasingly diverse classrooms.

But our work with elementary school children, teachers, and prospective teachers did not start in 2006, when we first made complex instruction a part of elementary math education at Michigan State University. It started years earlier with the work of one of us, Lisa Jilk, as a high school math

teacher, first in Minnesota and later in California. In the prologue, Lisa tells the story of her development as a high school math teacher, of the work that brought her to believe strongly that complex instruction could help her and others teach challenging mathematics conceptually to students in highly diverse classrooms and see all these young people learn.

This book is the result of collaboration among the six authors, to which all contributed equally, though differently. The order of names on the title page reflects alphabetical conventions and not a judgment on anyone's relative importance. Featherstone is listed first because she wrote the first draft of many, though by no means all, chapters. All six authors, however, discussed each chapter both before and after each of many drafts. All six identified issues that needed to be addressed and supplied new language. All contributed vitally important ideas and experiences, both through chapter revisions and through our discussions of the text. All shaped the manuscript significantly. Without the contributions of any one of us, the book would be different and not as good.

—Helen Featherstone, Sandra Crespo, Lisa Jilk,
Joy Oslund, Amy Parks, and Marcy Wood
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Prologue

This Felt Right to Me

Lisa Jilk

I began my teaching career believing there was a better way to learn math than the one I had experienced as a student. I determined that I would figure out how to create a classroom that matched this belief. Although I enjoyed school mathematics, I knew it only as a class where I quietly sat at my desk, copied the teachers' notes from the chalkboard into my notebook, and practiced the same problems repeatedly until I could recognize the problem type and reproduce the procedures that most often led me to a correct answer. To this day, I don't know why I continued to enroll in math courses long after I completed both high school and college graduation requirements. Maybe on some level I felt successful. I earned good grades, and I enjoyed following rules. Although I rarely understood where the rules came from or why they worked, choosing formulas, plugging in numbers, and following procedures gave me a sense of control that I often lacked in other parts of my life.

I struggled through my first three years of teaching math in a comprehensive high school in a first-ring suburb of Minneapolis. I touted teaching for understanding and collaborative learning as a preservice teacher, but I was completely ill-equipped to turn my vision into a reality. I sought out programs that afforded alternative teaching and learning practices, but I failed miserably with a toolkit that included a traditional math curriculum, some lofty theoretical articles from my preservice program, and a handful of kind, very well-intentioned colleagues. Although my classroom was a place where young people felt comfortable, respected, smart, and safe, I am not confident that they ever learned enough important mathematics.

In my third year of teaching, the school asked me to teach a third track of students who were not finding success in our math program. The department had decided to adopt the Interactive Math Program (IMP), a four-year program of problem-based mathematics supported by the National Science Foundation, with hopes that an alternative, more problem-based curriculum would serve these young people better. Teaching IMP gave me professional development opportunities that helped me shape new opinions about myself as a math learner. In school and in college I had, more often than not, entered math classrooms shy and fearful, with the goal of sitting quietly unnoticed until I could go home and try to make sense of the notes I took in class. Sitting in the back of the room and not participating was not an option in IMP workshops. The program positioned us, the teachers, as learners, put us in small groups, and asked us to investigate, probe, and question the math—exactly what we would eventually ask our own students to do. Experiencing the fear of not knowing, but working through my confusion with the support of the facilitators' good questions and scaffolding strategies, gave me the confidence to say, "I don't know, but I'll try to figure it out." For the first time, I was really learning math. I was struggling with ideas, drawing pictures,

having conversations, and exploring concepts, and no one ever told me I was wrong or stupid. Instead, they encouraged my ideas and applauded my perseverance. This was new and exciting, and in many ways this experience brought me out of the mathematical closet. I was very proud of my newly discovered abilities, and I finally understood how my participation in my own learning added to my mathematical competence. I knew then what I needed to do for kids.

I left Minneapolis and moved to northern California in the late 1990s. There, I found Railside High School (a pseudonym), one of the high schools that participated in a five-year, longitudinal research study led by Jo Boaler of Stanford University (Boaler and Staples 2008). Joanne Lieberman, currently a professor of mathematics education at California State University—Monterey Bay, was then teaching a course in my graduate program. She had recently completed her dissertation about the Railside math department as a professional learning community, and she suggested that I check the school out. I clearly remember the day of that visit, because my experience exemplified exactly what the Railside math program was all about. (Although I use the past tense when I describe the collaboration and teaching that took place at Railside when I was a teacher there, this same kind of work still happens at Railside today.) Hoping not to disturb anyone, I found a seat in the back corner of an algebra class. Little did I know that I had absolutely no chance of being overlooked or left to sit quietly and observe. Carlos Cabana, the department chair at the time, asked me up to the front of the room to help launch a lesson that I knew absolutely nothing about. I took a seat at the overhead and recorded information generated from a whole-class discussion. There I was, a stranger who just happened to stop by, gradually being drawn into this classroom community, and no one blinked an eye. Conversation moved easily among Carlos, the students, and me, and I felt connected to these kids and immediately invested in what they were learning. I soon learned that this way of being in math classrooms was commonplace at Railside. No one was a bystander, and everyone had something to offer and something to learn.

Soon after that memorable visit, Railside hired me as a long-term substitute teacher. I began my full-time tenure the following fall. When I joined the Railside math team in 1997, the department already had a strong reputation for collaborating in grade-level teams, creating curriculum around big mathematical ideas, and using groupwork as its primary mode of teaching and learning in all courses. I was very attracted to this model, and I was thrilled when Railside hired me. I imagined Railside as a place where I might learn to actualize the vision of teaching and learning math that had for years felt so elusive. Prior to my arrival at Railside, the department had detracked its math courses and begun a partnership with Elizabeth Cohen and Rachel Lotan at Stanford University in an effort to increase achievement and meet the demands of working with heterogeneous classes. The department had eliminated all prealgebra classes, and it now randomly placed every incoming, English-speaking ninth grader in an algebra class. It also offered a Sheltered Algebra course for students who were English language learners. Having eliminated ability tracking for tenth, eleventh, and twelfth graders as well, the department integrated most students with special needs into mainstream classes and moved all students through a college-preparatory program that included two years of algebra, geometry, trigonometry, precalculus, and calculus.

The student population at Railside has remained quite consistent over the years. In the late 1990s approximately one-third of the students were Latino, one quarter each European American and African American, and seventeen percent Asian American and Pacific Islanders. Ten percent were English language learners; 24 percent qualified for free or reduced-price lunch. At the time, Cohen and Lotan had developed the Program for Complex Instruction based on research focused on learning how to teach, at a uniformly high level, students who have a diverse range of prior knowledge, language abilities, and social status. Cohen and Lotan's work assumes that every child is academically competent. That work takes up the serious issues of social and academic status that run rampant in our society and often impede students' participation and learning. In our world, people often make decisions about other people's intellectual abilities on the basis of certain characteristics that the community values. Often, for example, because most communities have assigned more value to English than to other languages, people assume that others who do not speak English fluently do not have the same competence as those who are native English speakers. In the same way, many Americans believe that people with white skin are more intellectually capable than people with black or brown skin.

People then act from these assumptions. A student might ignore a Punjabi classmate's ideas and dominate the small-group presentation because she assumes that her partner's lack of fluency in English makes him dumb at math. A young black man may actively disengage from collaboratively doing a math task because he believes that the white students in his small group have more math skills. In both these examples, the girl who dominates or the young man who disengages, students are participating unequally and therefore missing out on valuable learning. Seeing how this might happen for the young black man is easy: no participation usually leads to less learning. However, what is more difficult to understand, but is just as true, is how the person who dominates the conversation, who takes over the task and does all the work, is also not learning enough mathematics. If we believe that learning mathematics requires participation with others around rigorous content, then the student who silences his groupmates will inevitably learn less than the student who engages with them in discussing the math.

Our students arrive in our classrooms with most of the assumptions about competence that pervade U.S. culture, and then they act on them. Some students do not want to participate in our classes because they do not feel smart. As I have said, that was me for many years. Some students completely dominate activities and conversations because they feel more intellectually able than their peers. We all know these young people. We have all seen these behaviors and chalked them up to personality, something we believe ourselves powerless to change. However, what we believe about our own intellectual abilities, and those of others, is very often a social construction reinforced over time rather than a mirror of reality.

At Railside, we math teachers held the unwavering belief that *all* students are smart and *all* students can succeed in learning mathematics. Therefore, Railside's partnership with Cohen and Lotan was an opportunity to marry beliefs with practice. When a school detracks courses, the vast range of prior math experiences and understandings that exist in one classroom can overwhelm even the best teachers. In addition, this diversity can make academic

and social status issues more visible. Cohen and Lotan's Program for Complex Instruction gave Railside's math teachers real tools for addressing these challenges. It helped us create classrooms where students worked together to dig in and make sense of rigorous mathematics, where students took responsibility for their learning and that of others, and where young people with diverse schooling and home experiences could work together to achieve their academic goals.

This felt right to me. This felt normal. A stance toward teaching and learning that prioritized the collective rather than the individual and collaboration rather than competition coincided with much of how I tried to live my life outside school. Learning is not a zero-sum game. Everyone can learn. Success does not have to come at another person's expense, and working together only makes us all stronger, smarter, and happier in the long run. My experience as a teacher at Railside supported these beliefs, and I watched as our students came to believe the same.

I remember the first Sheltered Algebra class that I taught at Railside. Thirty-two students ranging from 14 to 18 years of age, from different countries around the world, came to me with a hugely diverse set of previous math experiences, skills, and conceptual understandings. Most of these young people were from Mexico, Nicaragua, and El Salvador; several had recently arrived from Vietnam, China, and India. My responsibility for ensuring their success in algebra completely overwhelmed me. None of them were yet fluent in English, and I had not learned how to speak Spanish, much less Vietnamese or Punjabi. I learned that more than half of them had not successfully completed their eighth-grade math course.

I knew immediately that I absolutely could not do this work alone, and I was certain that the students looked at me on that first day and thought the very same thing. They probably wondered, "How in the world is *that white* woman going to teach us?" The very fact that I could not meet all my students' needs required me to rely on them for help. I needed their help to translate directions, to lean across tables and share ideas, to come up to the overhead and explain their reasons. I needed Chris to sit with Billy, because Billy was still angry with his parents for bringing him to California from Vietnam. I needed Lupe to tell Norberto and Ricky to sit down and be quiet every five minutes, because Lupe had "mothered" these young men throughout middle school and had an amazing skill for holding them accountable for doing their work. I needed Catherine to show Doris what it meant to combine like terms, because I didn't know how to say "combine like terms" in Shanghainese. Pablo had failed every math class he had ever taken, but he was 17 years old and needed to graduate. It turned out that I needed Pablo to show his group how to use rubber bands to create geometric shapes on a geoboard so they could apply their area formulas. What we in that classroom needed each day for mathematical success did not come from any *one* of us. It came from *all* of us using our strengths and skills to help everyone get the math they needed to learn.

This commitment to learning together, holding one another accountable for everyone's learning, was also being played out in the school's math department. Being a member of the Railside mathematics department meant that I was part of a team of teachers deeply committed to ensuring that every student who walked through our classroom doors learned rich, powerful mathematics. No teacher in the department blamed the kids, the parents, or

the community for difficulties they encountered trying to make this happen. Of course, we all wished for more money, time, and resources. Ultimately, though, figuring out how to engage each student in learning mathematics, and how to support their academic success, was our job. Starting with this commitment meant that we needed one another as colleagues. No one of us could take on this tremendous challenge alone. We met together weekly to create tasks and solve the never-ending list of problems and challenges we faced in our classrooms. We discussed students' understanding and misconceptions, crafted probing questions, analyzed students' work, and discussed our observations of one another's classrooms. We worked with administration and counselors to streamline schedules and figure out how to support our students. We launched each year with Algebra Week, a weeklong teachers' working retreat where we reconnected after summer vacation, reflected on the previous year's successes and challenges, and constructed new lessons and units for our ever-changing curriculum.

We worked tremendously hard to cocreate a mathematics program along with safe, positive communities where students recognized their own mathematical competences and learned to work together. This kind of commitment and support for one another helped English language learners successfully complete more upper-level math courses than I had ever seen before. I often heard students proudly state that they were smart in math and that math was their favorite subject. I watched 30 percent of 2002's graduating class successfully complete Advanced Placement Calculus. I learned that gender, race, language, or class do not determine a young person's ability to learn mathematics. Railside High's students and math department forever changed my life. They confirmed my beliefs that anyone can learn math and everyone should have the resources and support necessary to do so.

Take Carrie, a junior in my class, who was taking her first regular algebra class outside the special education department. Carrie came to me feeling stupid. She was terrified of being in this algebra class, because she was so comfortable with the special education teachers and program. Although I worked hard to convince Carrie that she could be successful with us, she did not finally buy into that idea until she started working with a group of young women from Mexico.

Carrie, Claudia, Maria, and Jensy were working together to build a "monster dog" that was six times the size of the original dog I had given them and to find the new dog's volume and surface area. For a group of four ninth graders who did not all speak the same language, this was a big project. Our classroom norms required that teams stay together on a task. No one was supposed to move ahead or go faster than the rest of the group, and we did not allow teams to split the work up into pieces for individuals to do. Together, the young women needed to figure out how large the new dog should be, build it out of graph paper, and write a final report to explain and justify their solution.

After a day of struggling with this task, Carrie wanted to talk to me. She looked concerned and asked me if this was a "special" class. I wasn't sure what she meant, and I was cautious about labeling this class Sheltered Algebra. Given Carrie's previous experiences in special-education math classes, I wanted her to feel good about her placement in *this* algebra course. I wanted her to feel comfortable and be willing to take risks with her peers. I wanted

other students to recognize Carrie's good math ideas, and I wanted her to participate more often. I knew that Carrie could be successful in this course, and I wanted her to believe this, too. When I pressed Carrie to tell me what she was worried about, she said, "I feel so smart in here! I get to speak Spanish all the time, because they need my help, and I'm really learning a lot of math." I was completely shocked. This young woman, who lacked academic confidence and who the school had positioned as a less-than-stellar special-education student for many years, was worried that something was wrong because she suddenly felt so smart!

I learned that day that Carrie was fluent in both Spanish and Portuguese. A math classroom where students worked individually and rarely spoke to each other might never have valued such language expertise. Carrie, however, found that this class desperately needed her strengths in Spanish, not because people wanted to learn Spanish, but because students who spoke Spanish needed access to math. Further, Carrie wasn't just a translator. In this classroom, she became a math learner who used both Spanish and English to interact with others while she and they learned algebra together. Carrie's Spanish fluency gave the Spanish-speaking students access to the math; simultaneously, Carrie gained access to new math ideas when she worked collaboratively with her team using Spanish. The nature of the Monster Dog task, the norms for collaboration, and the focus on students' strengths enabled these young women to complete their task successfully and to learn important mathematics.

When I left Railside to pursue graduate studies, I imagined that I would again join a community of like-minded educators committed to learning more about how to develop high-quality math instruction in our schools. Although most of those I met in the university wanted the best for all students, I realize now how naïve I was to think that we all had the same vision of how this should look. I struggled as I tried to share my Railside experiences and adapt these ideas to preservice teacher education. I learned a lot in graduate school. One thing that has stuck with me is that timing is crucial: no matter how good an idea is, until it meets opportunity, it often goes nowhere. After three years of reading, writing, talking, and exploring how my world of complex instruction might fit into the university, I saw things begin to happen. A few of us former Railside math teachers had begun sharing our work around the country. Then Helen Featherstone and Marcy Wood approached me. First, they wanted us to teach complex instruction to the prospective elementary school teachers in their classes. Then they wanted us to collaborate with other elementary math education instructors at the university, instructors committed to helping preservice teachers learn more about instructional practices that supported equitable participation in mathematical sense making. Bam! Our worlds collided. We all had things to learn with and from one another, and we used this opportunity to help preservice teachers believe in their own mathematical abilities and their capacity to achieve more equitable outcomes with students.

I am especially grateful for the chance to think and work with this very thoughtful, talented group of women. They challenge me to think about complex instruction in new ways, and they force me to clarify the connections among my beliefs and practices. This group has moved this work forward in ways important for math education in general and preservice elementary teachers' work in particular.

Complex instruction is not a magic pill. It contains no formula or checklist to follow. In addition to strong content knowledge, knowledge about students, and knowledge about how students think and learn math, successfully implementing complex instruction requires a deep belief that all students can learn, that teaching is more than delivering information, and that learning is more than listening. Complex instruction is, in fact, complex. Its components intertwine, and there is always too much to attend to. Given some extra time, resources, and support, very committed groups of math teachers at Railside—and now elsewhere—are using these ideas and practices, and they are making it work! Yes, *we* can!

This book offers a starting point for teachers who believe as I did early in my teaching career. I held great hopes for my students, but challenges that seemed impossibly immense overwhelmed me. This book offers a place to start growing new practices for helping students both make sense of mathematics and see mathematics as a social activity, as something worth doing together. My wish for those who read this book is that they trust their students and themselves to create the kinds of classrooms that inspire everyone to engage and learn.

Reference

Boaler, Jo, and Megan Staples. "Creating Mathematical Futures through an Equitable Teaching Approach: The Case of Railside School." *Teachers College Record* 110, no. 3 (March 2008): 608–45.