 Linda Sims

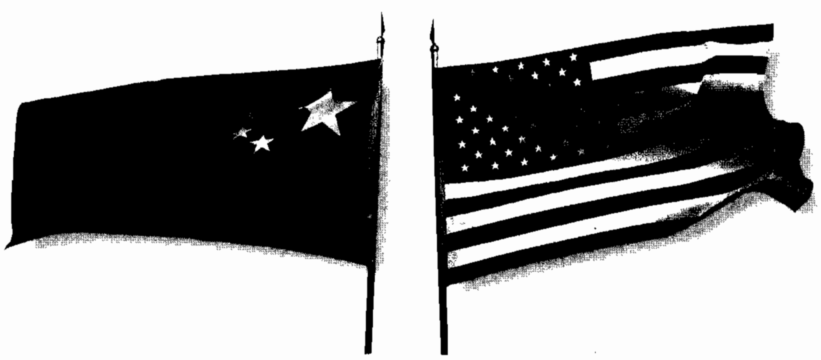
Look Who's Talking: Differences in Math Talk in U.S. and Chinese Classrooms

After twenty-three years of teaching, I stepped out of the classroom and into the world of education research. As part of a team of researchers comparing mathematics teaching and learning in the United States and China, I spent many hours watching videotaped mathematics lessons from fourth- and fifth-grade classrooms in both countries. It was fascinating. (To be honest, it was luxurious, since I was not also trying to grade spelling tests while I watched.) After I got past my initial reactions to the foreign setting—including bare walls, desks in rows, and over forty students per class—more substantive features of the differences between Chinese classrooms and what I was accustomed to seeing in U.S. classrooms began to capture my attention.

For example, the Chinese teachers did not appear to talk as much as the U.S. teachers. And, in contrast, the Chinese students seemed to talk much more than the U.S. students did. In the U.S. videos, I saw familiar scenes: numerous manipulatives, creative activities, tables set up with mathematics games—all designed to engage students in the mathematics. In visual contrast, the crowded Chinese classrooms seemed almost bare: a teacher and her students; pencils and paper; thin, paperback textbooks. Yet this was somehow enough; the students clearly engaged with the mathematics. In the Chinese classrooms, the star attraction was the *mathematics,* and the core ideas were most often featured through *student talk.*

The idea of "math talk" was certainly not new to me. I was aware of the importance of purposeful discussion as a major element in mathematics reform. In the early 1990s, when NCTM called attention to classroom dialogue, leaders in the educational community began pressing for teachers to analyze how they currently used conversation in mathematics classrooms and to consider how they could use it more effectively (Ball 1991, 1993). Researchers looked closely at how teachers—through selection of activities, instructional style, and, yes, classroom talk—shaped students as active, verbal lesson participants. Their findings suggested that student achievement and engagement are enhanced when students receive opportunities to explain and justify answers, compare multiple solution strategies, and accept and learn from errors (Kazemi and Stipek 2001; McNair 1998; Rittenhouse 1998; Turner and Meyer 2004; Turner and Patrick 2004; Whitenack and Yackel 2002). These findings were familiar to me; I would have nodded in agreement with anyone purporting the benefits of student math talk. Yet I was still taken aback by the striking differences I saw in the videos. I was convinced that I had not given math talk its deserved place in my own teaching repertoire, and I resolved that should I ever return to teaching, I would work hard to include more math talk, especially from my students.

I shared these observations and reactions with my research colleagues. We were intrigued and decided to quantify my initial impressions through a more formal investigation of teacher and student talk in Chinese and U.S. classrooms. In the end, these and related investigations (Schleppenbach et al. May 2007; Schleppenbach et al. November



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2007) not only confirmed my initial observations, but actually revealed greater differences than I originally imagined. This article presents the results of two investigations that look closely at math talk in Chinese and U.S. classrooms and examines the questions these studies raise about how we go about the business of teaching elementary mathematics.

Study 1: Chinese and U.S. Classrooms

As mentioned previously, one of my initial observations of the Chinese mathematics lessons was that the students engaged in a large amount of math talk. Therefore, we began our investigation by directly comparing the math talk in Chinese and U.S. classrooms. By closely examining twenty-eight videotaped lessons from fourth- and fifth-grade mathematics classrooms in both countries, we hoped to capture *how much* math talk took place as well as *who* was doing the talking in these classrooms. (The data were originally collected as part of a larger investigation, the intent of which was to collect and catalog video data of mathematics classrooms for the purpose of understanding successful teaching and learning practices in China and the United States.)

To answer the questions of how much math talk took place and who was doing the talking, we transcribed all the dialogue in the lessons and then split each transcript into two parts, one consisting only of the teacher's words and the other of students' words. From these split transcripts, we compared what the teachers were saying to what the students were saying.

Teachers talked more than their students in both countries, as measured by the total number of words uttered in a lesson (student words plus teacher words in all statements produced in the lessons). However, this difference was more dramatic in the U.S. classrooms, with teachers producing 89 percent of classroom discourse (as measured by number of words uttered) compared to 65 percent in the Chinese classrooms.

We then searched the separate teacher and student transcripts for the presence of *math talk*, which we defined as explanations, declarations of formal principles or procedures, and other mathematical statements. When we narrowed our focus to include only mathematical statements, we found a striking difference: In U.S. classrooms, *teachers* produced the vast majority (79 percent) of the mathematical statements; Chinese classrooms showed the inverse pattern, with *students* producing 69 percent of the mathematical statements (see **fig. 1**).

In sum, Chinese students produced both more total talk in classrooms and more mathematical statements compared to their U.S. counterparts. Some excerpts from the U.S. and Chinese lessons, presented in **figures 2** and **3**, illustrate this contrast further. As you examine these excerpts, pay particular attention to how much the teacher talks compared to how much the students talk.

The investigation results clearly point to differences in the frequency of student and teacher math talk in Chinese and U.S. fourth- and fifth-grade classrooms. Further analyses (Schleppenbach et al. May 2007; Schleppenbach et al. November 2007) pointed to even more striking differences in the *character* of this talk. For example, teachers in our video sample of Chinese classrooms explored errors in greater depth. They also pushed students to evaluate and explain their reasoning, even after responding with correct answers. Predictably, these findings sparked many discussions about the reasons behind the different math talk norms in these classrooms.

Would the U.S. results have looked different if we had examined only classrooms that used a discourse-focused reform curriculum? (None of the classrooms in our initial study used an NCTM-inspired reform curriculum.) Because reform curricula are specifically designed to promote student dialogue (Wagreich et al. 1997), a logical next step would be to apply the same analytical lens to U.S.

Figure 1

Proportion of mathematics statements produced by students

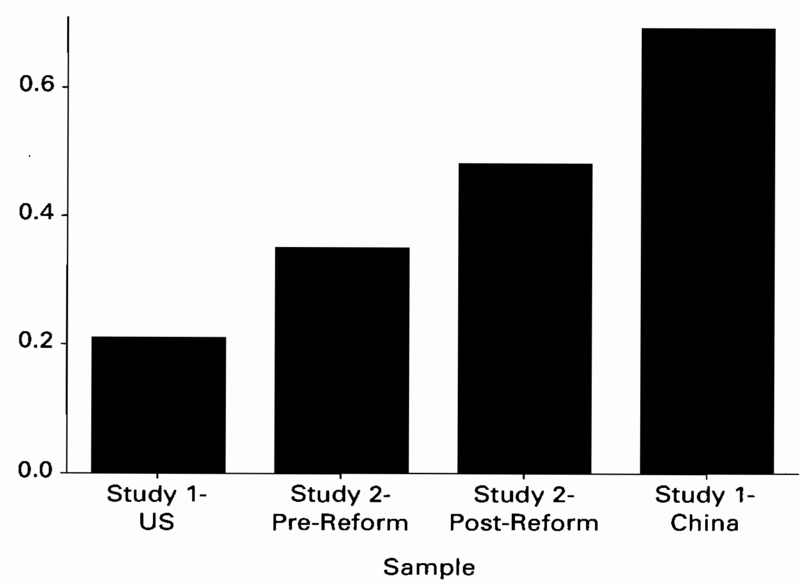

Figure 2

Excerpt from a typical U.S. lesson
(teacher contributions are noted in bold)

T: **OK, today we are going to learn about something called equivalent fractions. And all year we have been talking about how a number can have more than one name or there can be more than one way to express a number. On the test you just took, there was a whole section about the number 27. Do you remember that? And you were supposed to write or express the number 27 in many ways. And you all did a great job, so I know you understand that a number can have many different names, many different ways of expressing it. And the same thing is true for a fraction. A fraction can have many different names and mean the same number or same amount. Kristen?**
S: I have an example of two numbers. Like three-sixths can be one-half because it is half of something.
T: **Good. And that's exactly what we are going to be learning today. Kristen said that three-sixths and one-half equal the same thing, they represent the same amount. And that's what we mean by an equivalent fraction. Now let's begin with a little review. What is a fraction and why do we need fractions? Why do we need to be able to write numbers in fraction form? Andrew?**
S: Because we need, if there's more than the number and less than the other, we need something in between.
T: **Okay. Alright. What do you think, Josephine?**
S: If there's less than a number, then you'll need to write like a half.
T: **Less than which number?**
S: One.
T: **Less than one. Okay? If we want to talk about less than one, we need some way to express it. You already learned one way to do that. What unit did we have recently where we learned a form in which we can write a number when it was less than one whole thing? Corey?**
S: Decimals.
T: **Decimals. We just finished a unit on decimals, so you already know about decimals. And fractions and decimals are very much related to each other. So a fraction is another way to express something that is less than one whole thing. So, if you buy a gallon of milk at the grocery store and you only drink one cup for breakfast, you didn't drink the whole gallon, did you? And so you need some way to talk about less that that whole gallon of milk. If you order a pizza—if it's a large pizza—probably you can't eat the whole thing. And you need a way to talk about what part of that pizza you ate. Now you also need to know that we have special names for the numbers in a fraction. And what do we call the top number? Gina?**
S: Numerator?
T: **It's called the numerator. And this should be review from last year. And Tessa, what do we call the bottom number?**
S: Denominator.
T: **The denominator. Those are important to remember because we'll be talking about those terms a lot. And then I told you what this line in the middle means. And we've talked about that all year too. That little slanted line. You can either write it like this or you can write it slanted. And what does that line mean always? Jacob?**
S: It's the divide sign.
T: **It's the divide sign. It's one way of expressing division. So this really means three divided by six. Ok, and that's how you change a fraction to a decimal, which we're going to be doing later on this morning.**

lessons specifically designed to promote student math talk. Thus, we designed a study to answer the question: Does the implementation of a reform curriculum change classroom dynamics in such a way that U.S. classrooms exhibit participation levels closer to what we find in Chinese classrooms?

Study 2: U.S. Reform Mathematics Classrooms

To conduct our study of talk in U.S. reform mathematics classrooms, we analyzed thirty U.S. fourth-grade lessons (McConney 2003). These data included videotaped classroom observations of three U.S. teachers who used a traditional mathematics curriculum in year one and a reform curriculum, Math Trailblazers, in year two. For each teacher, we studied a set of five lessons from each year. We performed the same analyses of the frequency of student and teacher math talk as in the previous investigation into Chinese and U.S. classrooms.

Our findings regarding word utterances as measured by the total number of words uttered across all lessons (student words plus teacher words) were similar to the U.S. classrooms in the first study. Teachers talked more than their students in both year one (89 percent of all words uttered came from teachers) and in year two (81 percent came from teachers). Although we found a relative decrease in teacher talk from year one to year two, the decrease was not dramatic.

Teachers' production of mathematical statements went virtually unchanged, from a total of ninety-three in year one to ninety-seven in year two. However, when we looked at students' production of mathematical statements, we witnessed an increase of almost double (from fifty-one to ninety) after the adoption of the reform mathematics curriculum. Thus, the relative proportion of student math talk changed to more closely resemble what we observed in the Chinese classrooms. In addition, we found that in year one, teachers produced the vast majority (65 percent) of the mathematical statements. In year two, after reforms were instituted, the students contributed considerably more mathematical statements than in year one (producing 48 percent of all the mathematical statements in year two compared to 35 percent in year one). **Figure 1** shows the amount of math talk produced by students across both studies.

Discussion

After our research group completed these studies, I wondered, as a former teacher, what all this actually means in terms of teaching. Certainly, we can make the claim that reform curricula may be an important aid in improving student participation, but, by itself, it is no panacea. The Chinese teachers did not use what we would consider a reform curriculum, yet student contributions to the mathematical discussions were abundant. Clearly, what a teacher thinks and does plays a major role in shaping classroom discussion norms. Looking beyond the obvious, other important considerations began to emerge.

First, I was struck by what teachers' instructional decisions imply about their underlying convictions about students' proper roles in a mathematics classroom. As I witnessed the abundance of teacher-orchestrated student discourse in the Chinese classrooms, a clear message came through the subtext: Student contributions are crucial to learning. When students' contributions predominate, students appropriate a shared (albeit tacit) belief that they and their peers are responsible for maintaining high levels of classroom discourse and for persistently exerting effort to achieve their own learning. Naturally, I began to wonder about what *my* teaching practices said about my own beliefs. I thought back to all the times I had interrupted a child's explanation with the noble intention of helping him articulate his thoughts more clearly or the times I had quickly moved on to the next question as soon as I received a correct answer. Had my interruptions sent the message that students were incapable of expressing ideas clearly? Did my excited affirmations of correct answers send the signal that accuracy and efficiency were more valuable than debating mathematical ideas or struggling with important concepts? As Pajares noted, the assumptions we make about our students' abilities and how our students acquire mathematical knowledge are likely manifested in our practice (1992). In other words, our actions speak volumes. If we want to encourage meaningful student contributions in mathematics class, we must occasionally step back and consider what our instructional practices say about our beliefs. We must ask, "What do my words and actions say about how I evaluate student contributions in my classroom?"

Second—and perhaps most important—I was struck by my surprise at our research findings. Could I trust my perceptions about the amount of math talk going on in my classroom? When I originally watched the videotaped lessons from China and the United States, it was obvious that the Chinese students were engaged in more math talk, but I was truly astonished when I examined the transcripts that showed the U.S. student talk. "Where's the rest of what they said?" I wondered. "This can't be everything." After so many years of teaching, I expected myself to be a better judge of this phenomenon—yet I had clearly overestimated the frequency and quantity of students' contributions to classroom discourse. Perhaps the frantic pace of my classroom life had robbed me of the chance to step back and absorb important details. Perhaps I had planned so

Figure 3

Excerpt from a typical Chinese lesson
(teacher contributions are noted in bold)

T: **The first one is a quick calculation. Stand up when you know the answer. Let's see who can be the first. (Teacher holds up cards with addition and subtraction of fraction problems.)**
S: 8/11.
T: **OK. Next. Ready?**
S: 3/14.
T: **See if you can be faster.**
S: 7/12.
T: **Make sure to reduce it to the lowest terms.**
S: One.
T: **Good! Sit down, please. Very good job of mental calculation. Remember, in this practice, pay attention not only to speed, but also to accuracy. Now, do you recall how to calculate the addition and subtraction of fractions with the same denominator? Chen Xu?**
S: Add or subtract the numerators while keeping the denominators unchanged.
T: **Is that right?**
S: Yes.
T: **Okay. When you add or subtract fractions with the same denominator, keep their denominators unchanged and add up the numerators. What does it mean to keep the denominator unchanged? And what does it mean to add up or subtract the numerators? Zhang Rui.**
S: Unchanged denominators refer to the unit of the fraction. To add or subtract numerators is to add or subtract the number of fractions.
T: **The fractions ...?**
S: Unit.
T: **The number of fraction units. Very good. Now let's review the following content that we studied in the past. These are completions. Please raise your hand to answer. Zhong An?**
S: 3 ones plus 2 ones is 5 ones.
T: **Quite easy, isn't it? Zhangzhong?**
S: 3 tens plus 2 tens is 5 tens.
T: **Wangmiao?**
S: 3 tens plus 2 ones is 32 ones.
T: **In other words ...**
S: 32.
T: **But shouldn't we just say "3 plus 2 equals 5"? Chengzhaoyu?**
S: No, because the units are different.

many lessons and considered so many concepts that I wrongly assumed that my thinking must surely mirror my students' thinking. As an experienced teacher, it was unsettling to consider that I could not necessarily trust my perceptions. But the undeniable evidence of the transcripts provided a long-overdue reality check that was impossible to ignore.

I encourage you to arrange your own reality check. Record yourself on audiotape (or videotape) for just ten minutes. Or pair up with a colleague and observe and take notes on how much the students are talking. More important, pay attention to the feature over which you have the most control—how much *you* are talking. You may be surprised. (For additional background and practical tips about creating a discourse-rich classroom, see, for example, Amos 2007; Chapin, O'Connor, and Anderson 2003; and Charles 2006).

When I was teaching, I could not have envisioned a classroom where students talked twice as much as I did. But, as I learned from this study, this is exactly what happens in a discourse-rich classroom. I can imagine this now—and perhaps that is the first step. I can see myself as one who directs, not dominates, the discussion. I can hear the lesson unfold in the voices of the students as they share their problem-solving strategies, confusion, or challenges to others' ideas. I am not saying it would be easy—but I believe it would be worth my best effort. As teachers, we can arm ourselves with promising new curricula that promote important math talk among our students, but ultimately it comes down to what we do and say—or do not say. I urge you to think before you speak: Letting our students provide most of the mathematical talk in our classrooms may allow them to own the mathematical knowledge in a much deeper way than if we try to hand it to them.

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