

Closing the Teaching Gap

The hard work of improving teaching in the United States can't succeed without changes in the culture of teacher learning.

By James W. Stigler and James Hiebert

Although the policy context that surrounds education changes like a series of hurricanes blowing across the Gulf of Mexico, the substantive nature of what happens in classrooms stays pretty much the same. In fact, this is what we would have predicted if teaching is a cultural activity, and after years of studying teaching here and elsewhere, we are convinced, more than ever, that it is.

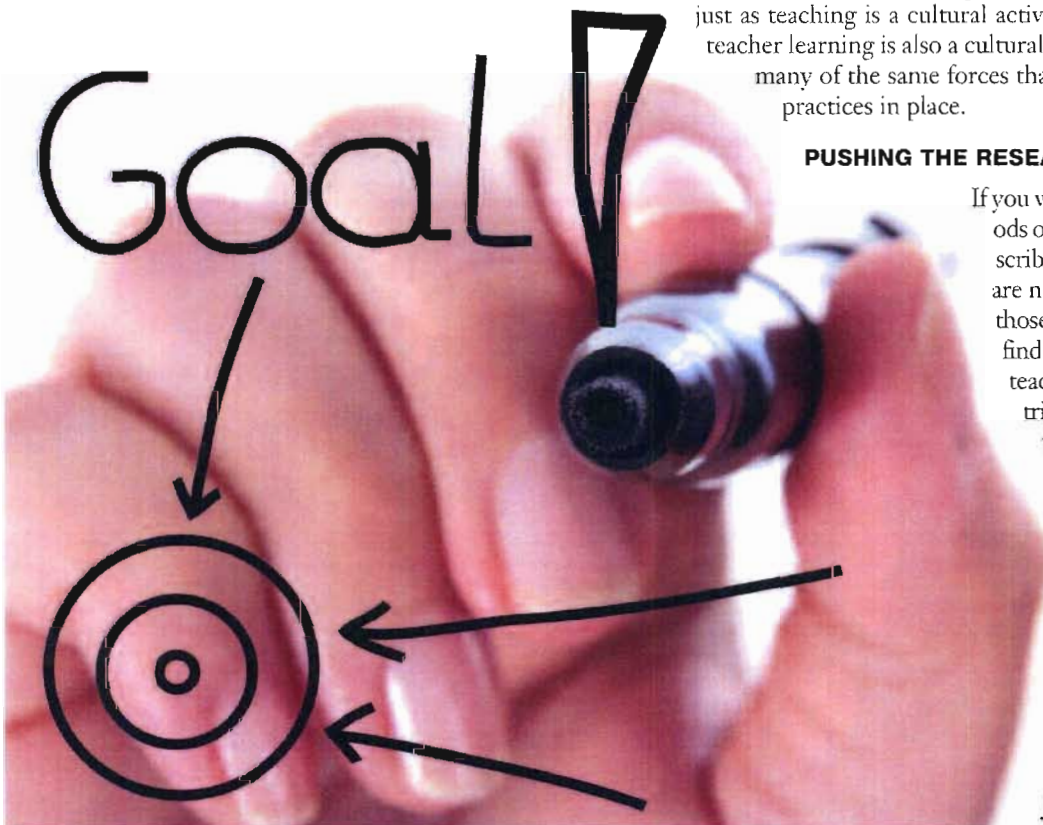
Our book, *The Teaching Gap*, which was published in 1999, was primarily a report covering a large research project, the TIMSS 1995 Video Study, which looked at mathematics teaching in three countries: Germany, Japan, and the United States. We followed that publication by embarking on a new study, this time in seven countries — the United States and six high-performing countries. The most important things we have learned

since we wrote *The Teaching Gap* revolve around the fact that, just as teaching is a cultural activity and difficult to change, teacher learning is also a cultural activity and thus subject to many of the same forces that keep traditional teaching practices in place.

PUSHING THE RESEARCH FORWARD

If you were impressed by the methods of teaching used in Japan (described in *The Teaching Gap*), you are not alone: Readers, especially those from the United States, find the Japanese pattern of teaching both foreign and intriguing at the same time. And, the more mathematically sophisticated the readers, the more struck they are by the elegance with which Japanese teachers engage their students in doing important mathematical work, work that focuses on core mathematical ideas and their applications.

That we concluded Japan's method of teaching



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is essential for high achievement is, however, a common mistake that readers make when reading the book. There were only three countries in what we now call the TIMSS 1995 Video Study, and only one of them — Japan — was high achieving in mathematics. Based on this study design, it is highly problematic to conclude that the Japanese methods of teaching have anything at all to do with their high levels of achievement. Many factors differentiate Japan from countries such as the United States, and teaching may not be the factor that explains student achievement. (For example, motivational factors may be more important.) But even if teaching is critical (and we believe it is), one would need to look at teaching methods in other high-achieving countries to see if they resemble the methods used in Japan. In other words, before we scrap our American teaching methods and copy the Japanese, we first need to understand whether Japanese methods are necessary for high levels of achievement. If the teaching methods of other high-achieving countries resemble those in Japan, we might conclude that we need to teach in similar ways to get similarly good results. But if other high-achieving countries look different from Japan, we would conclude that there are other ways to teach mathematics effectively.

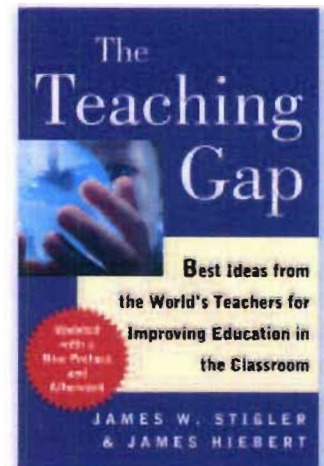
With such questions in mind, we set out to conduct the TIMSS 1999 Video Study. The key improvements over the TIMSS 1995 study were: 1) the inclusion of more higher-achieving countries (specifically, Australia, the Czech Republic, Hong Kong, the Netherlands, and Switzerland in addition to Japan); and 2) a richer, more refined coding system, which allowed us to capture more aspects of teaching in each country. We also were interested in what might have changed within U.S. classrooms since our 1995 study. Many policy initiatives undertaken in that period were designed to improve the quality of mathematics teaching in U.S. classrooms,

and we wondered if we could find evidence that things had improved since our initial study.

LITTLE HAS CHANGED IN U.S. CLASSROOMS

In *The Teaching Gap*, we painted a rather bleak picture of 8th-grade mathematics instruction in the United States. We noted that the patterns we observed in the videotapes were similar to those described by American researchers for the past 100 years, and we argued that the concept of teaching as a “cultural activity” could help explain the stability of teaching patterns over time. Would teaching change between 1995 and 1999? If teaching is a cultural activity, it probably wouldn’t. But the years between the two studies were an especially active time in U.S. mathematics education. Maybe the strong initiatives launched by major professional organizations would have an impact on the nature of classroom teaching. Listening to the teachers involved in the 1999 study suggested this might be the case. Many of them reported an awareness of the major mathematics education reform documents and even described changes in their teaching, changes that would be evident, they said, on the videotapes.

The findings can be easily summarized: Despite massive efforts to improve teaching in the United States, and despite perceptions by many that teaching was, in fact, improving, we found no evidence that anything had changed between 1995 and 1999. Students still were



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spending a large amount of time during each lesson reviewing material already learned in earlier lessons, and most lessons were devoted to practicing mathematical procedures rather than developing conceptual understanding. Students' learning opportunities had not changed.

MANY WAYS TO TEACH EFFECTIVELY

We now come to the question of what teaching looks like in high-achieving countries. Recall that in the TIMSS 1995 study, there was only one high-achieving country, Japan, and that teaching did look quite different there than it did in the United States. In the 1999 TIMSS, we looked at other countries with high mathematics achievement. Did we find that patterns of classroom instruction in these other

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countries resembled those in Japan? In short, we did not. The teaching methods in each of these high-achieving countries not only looked quite different from those in Japan, they also looked quite different from each other. In other words, it appears that there is not one way to teach effectively, but many.

Furthermore, many of the superficial features we might have expected to differentiate teaching in high-achieving countries from teaching in the United States varied as much among the high achievers as they did between those countries and the United States. For example: Is it better for a teacher to lecture or for students to work in groups? Is it better to use real-world situations when teaching mathematics or to focus just on the mathematics? Education reformers in the United States often discuss such variables and believe that they affect student learning. Yet in our study, these superficial variations did not show any clear relationship to cross-national patterns of achievement. Teachers in the Czech Republic and Hong Kong spend much of their time teaching the whole class, whether through lecture or recitation. Teachers in the Netherlands, on the other hand, have students work independently for much of the lesson, sometimes intervening very little in the flow of work. This variation among high-achieving countries calls into question the popular strategy of identifying "best practices" by benchmarking ourselves against the high-achieving countries. If we look a little deeper, however, a different story emerges.

WHAT HIGH ACHIEVERS HAVE IN COMMON

Despite the apparent variation among high-achieving countries, we found deeper similarities.

The key to finding these among the high achievers was to look not just at teaching itself but at the effects of teaching on students' experiences during the lesson. Although teachers in the high-achieving countries employed a variety of strategies and routines, in every case these strategies were used to achieve a common learning experience for students. Czech teachers might lecture, and Dutch teachers might not, but their varied approaches all accomplished the *engagement of students in active struggle with core mathematics concepts and procedures*. It was this feature of teaching that we found common to the high achievers and missing in the United States.

This conclusion emerged from a detailed analysis of the kinds of mathematics problems presented to students and the way these problems were worked on during the lessons. Most of mathematics class time in all countries, about 80%, was devoted to working on math problems. But countries differed considerably in the kinds of mathematics problems presented to students. In Japan, the majority of problems presented to students were designed to focus attention on *relationships* among ideas, facts, and procedures, whereas in Hong Kong, most of the problems required students to *practice procedures*. The types of problems presented in the other countries, including those in the United States, fell somewhere on a spectrum between these two methods.

Because there was great variation among the high-achieving countries and the United States was no different from the rest, the types of problems presented did not appear to explain cross-national differences in achievement. When we looked more closely at the videos, however, something more interesting started to emerge. Though there was no clear relationship between the kinds of problems *presented* and the national levels of achievement, we did notice striking differences between high-achieving countries and the United States in the way teachers worked on the problems with the students. The difference appeared to be not in the problems themselves but in the way teachers used the problems to teach the concepts. The key, in other words, seemed to lie in the teaching.

To test these observations, we coded problems a second time, focusing on how teachers implemented the problems during the lesson. Anyone who has observed a math class knows that teachers can step in and change the nature of the problem. For example, take the presented problem, "Find a pattern for the sum of the interior angles of a polygon." There are various pedagogical approaches to this problem that would highlight important mathematical relationships. Students could use protractors to measure the sum of angles in various three-sided, four-sided, and

To learn more about the TIMSS results, visit <http://nces.ed.gov/timss/index.asp>

five-sided polygons and then study the results. Or students could divide the polygons into triangles and study how many triangles can be formed in polygons with different numbers of sides. Teachers, however, could step in and change the intent of the problem by telling students to find the sum of the angles by counting the number of sides, subtracting 2, and multiplying by 180. The problem would now become one of, rather than searching for patterns, practicing an arithmetic procedure. The learning opportunities would be vastly different.

Coding the problems a second time revealed a striking similarity among higher-achieving countries. About half of the problems in these countries emphasizing relationships were worked on with students to do just that. The other half of such problems in these countries were changed so that students practiced procedures or recalled information they had learned before. In contrast, few problems in the United States with the potential to emphasize mathematical relationships were used to teach these relationships. Nearly all of them were used merely to practice procedures or recall information. Teaching had trumped the curriculum and had dramatically altered students' learning opportunities. And students in the United States, compared with their

peers in higher-achieving countries, ended up with very few opportunities to learn the concepts.

A CLEAR GOAL, BUT A GRAND CHALLENGE

These findings extend those of the 1995 Video Study by showing that, on the one hand, teaching varies among high-achieving countries. No single approach has a monopoly on students' learning. On

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the other hand, there are a few pedagogical features that high-achieving countries share and so are worth U.S. educators' attention. In particular, mathematics teaching in high-achieving countries appears to both 1) attend to important mathematical relationships, and 2) involve students in doing serious mathematical work. The importance of both of these features for facilitating students' conceptual understanding *and* procedural fluency is corroborated by independent research on mathematics teaching and

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In order to improve the teaching of math in the United States, we need to engage students in exploring mathematical relationships and wrestling with key mathematical ideas. Unfortunately, it's not possible to achieve this goal simply by identifying best practices. This is what many people expected from *The Teaching Gap*, and we still get asked to describe, and show on video, examples of best practices used in the high-achieving countries that we could copy and use in the

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United States. Given what we know about the cultural nature of teaching, this strategy is unlikely to work. However, given what we now know about the variety of teaching approaches that are related to high achievement, this strategy is no longer necessary.

Rather than imitating the techniques of teachers in other cultures, teachers should learn a variety of instructional strategies that attend to key mathematical relationships and engage students in mathematical work. They must also learn to monitor what students are experiencing, thinking, and learning during a lesson and be able to constantly readjust their strategies in order to capitalize on every opportunity for students to learn. Of course, this doesn't make the task itself easier. Even though a variety of teaching approaches can be successful, improving student learning will require substantial teacher learning. And teacher learning remains an underestimated challenge for U.S. education.

IMPROVING TEACHING

One of the most important things we've learned since the publication of *The Teaching Gap* is that learning to teach is as much a cultural activity as is teaching itself. The United States has developed professional development practices for teachers that have become ingrained in the culture. These usually involve professional developers (presumed experts) presenting workshops for teachers during specially designated days during the school year. These professional development practices, just like teaching methods, have become so common that they're almost invisible, accepted as the way things are done, though the results of these practices have produced few changes in teaching.

Recently, the traditional forms of teacher development have come into question, and more attention is being paid to alternative learning opportuni-

ties for teachers. As with teaching, by looking at how other countries provide learning opportunities for teachers, we can see our own practices more clearly and ask whether other practices might work better.

In *The Teaching Gap*, we presented one example of how teachers in another country learn to teach. *Lesson study*, a form of teacher development in Japan, breaks away from the model of experts telling teachers what to do. Rather, it assumes that teachers learn to teach by treating teaching as an object of study — by trying to improve teaching by studying carefully what works and what doesn't. It folds together the processes of learning to teach and improving teaching. Although professional development practices, like lesson study, have emerged as important alternatives to traditional teacher learning opportunities in the United States, it is clear that numerous subtle but powerful cultural forces work to keep conventional teacher training in place.

LESSON STUDY: A MULTITUDE OF GRASSROOTS EFFORTS

We, of course, didn't invent lesson study. But we emphasized it in *The Teaching Gap* because it is based on features that research shows are essential for teacher learning and teaching improvement. These features have been successful not only in many Asian countries but also in the United States. For example, for teachers to learn things that help them teach more effectively, the learning opportunities need to be tied to the curriculum they are teaching students. This means that learning involves deepening the teachers' knowledge of the content they will teach as well as gaining possible strategies for teaching that content. In addition, useful learning opportunities for teachers involve trying to understand how students are likely to best learn the content and what difficulties they're likely to encounter. These learning opportunities are most useful when they occur with teachers who share the same learning goals for students and who are willing to open their classroom doors so teaching can become a shared object of study. In this environment, different approaches can be planned together, tested in multiple classrooms, and revised based on their effects on students' learning.

In spite of the success of professional development practices that include these features, teachers who attempt to implement them in their own schools and districts can become frustrated with the cultural forces that try to keep more traditional approaches in place. We have heard from many "pioneers" who are trying to change the culture of teacher learning but are bumping into this kind of resistance. In addition, those who endorse teacher learning opportunities like lesson study often view the practices through their own cultural lenses and unintentionally distort

key features. For example, lesson study might be enacted as an activity of planning a lesson together without the critical follow-up of observing the lesson in several classrooms, gathering information on its effectiveness, and revising the lesson accordingly. We're convinced that the hard work of improving teaching can't succeed without changes in our culture of teacher learning. Teacher learning is the key to improving teaching. But not any kind of teacher learning will do. Listening to experts during special professional development days does not translate into improved teaching. Effective teacher learning must be built into teachers' daily and weekly schedules. Schools must become the places where teachers, not just students, learn.

CLOSING THE TEACHING GAP

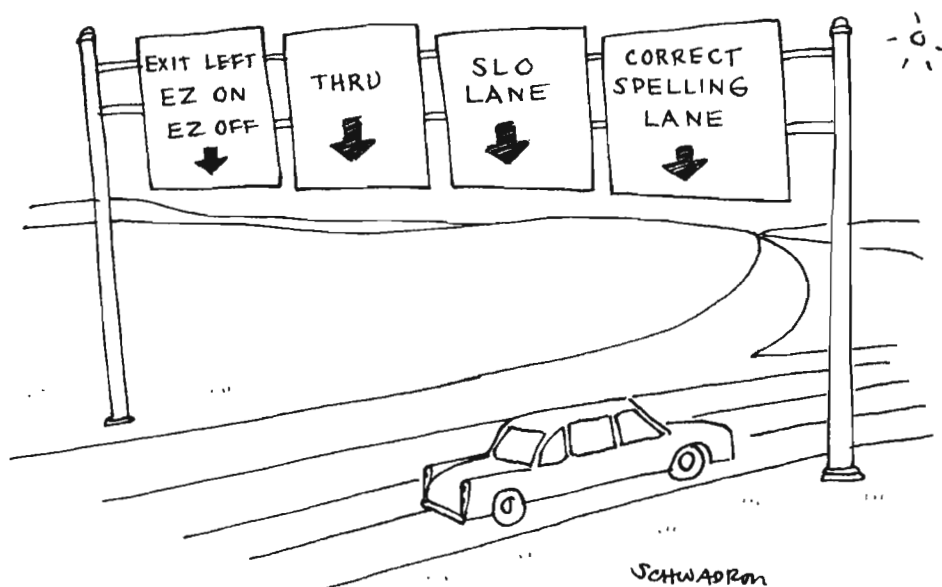
Perhaps the most interesting aspect of lesson study is the mechanism it provides for studying and improving the methods teachers use. Teachers in lesson study groups are not only improving their own knowledge and skills but are also contributing to a knowledge base that may, potentially, inform more permanent improvements over time. Lesson study shifts our focus from teachers to teaching, a necessary shift if teaching is ever to become a knowledge-based profession. By seeing teacher learning as necessarily tied to the study of teaching, U.S. educators can begin to change the culture of teacher training.

We know more now than we did a decade ago about what it will take to improve teaching. We know that there is not one best way to teach but a variety of methods that can be used effectively, depending on the context. We know that these methods can be studied and improved, and we know that

developing the evidence for good teaching — for understanding how and when and under what conditions various strategies work — will require collaboration among researchers and teachers. And we know that the ultimate standard for good teaching will be in the kinds of learning opportunities that teaching creates, and that students are able to use in the classroom. In mathematics, we know that high-achieving countries succeed not by using particular methods but by finding ways to engage students in sustained efforts to grapple with mathematical ideas and relationships.

We also know that becoming an expert teacher will require consistent opportunities over long periods of time for teachers to study and improve their own teaching and the teaching of their colleagues. Teaching the same old way is natural. Teaching in new ways is far more complicated than many think. Teachers must have knowledge of the domain (for example, mathematics) and of how students think about and learn the domain. They must also have skills at implementing a variety of different methods that have been validated and incorporated into a growing knowledge base for teaching. Finally, they must have the skills to assess what students know and where they are in a learning trajectory, as well as the judgment to decide which of the methods in their repertoire to deploy when.

If we can broaden our definition of the teacher's job to include continual improvement of teaching methods and continual improvement of their own knowledge, skills, and judgment, and if we can provide stable settings at the school site in which this work can take place, then we can make significant progress in closing the teaching gap. ■



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