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A Call for Substance:
An Interview with Dr. William Schmidt

William H. Schmidt is the National Research Coordinator and Executive Director of the U.S. National Center which oversees participation of the United States in the TIMSS studies. As a professor at Michigan State University, he is also widely published in both journals and books on mathematics education. In March 1998, The Math Projects Journal *had an opportunity to sit down with Dr. Schmidt to discuss the TIMSS 1995 report and what it has to say to American educators.*

MPJ: Can you give an example of a model lesson from one of the top achieving countries, either Germany or Japan, which are the focus of the videos?

Dr. Schmidt: Let's cut to the chase. If you look around the world, there just isn't a single way to teach that is dominate among the top achieving countries. Some of them are very didactic, lecture-oriented classes. Some of them are like the kind that you see in the Japanese tapes. If teachers know their mathematics well, they can be just as engaging through a lecture format, as they can teaching as the Japanese do. It is very clear to me that there isn't one way to do this. Instead, the more analysis that I do, the more I believe that there are some principles involved here that just might go across countries.

MPJ: What is that common thread?

Dr. Schmidt: I think the common thread that makes for the top-achieving countries is pure, honest-to-goodness mathematical substance. If the teachers really know and understand the mathematics, then they bring that to the students, through whatever means they know best. Also, a large part of this idea is to develop this stuff conceptually and not just algorithmically. I think many people misunderstand the Japanese videos. It is not so much the methodology, as it is the mathematics. You watch those lessons and the instructor really understands the mathematics, engaging those students in more ways than we do in this country.

MPJ: So, if a teacher were to do a dog-n-pony show lecture with drill-n-kill practice, and do it well, would it work?

Dr. Schmidt: The dog-n-pony show lecture, yes. The drill-n-kill, no. That's what I said about there being some principles. I think the common element is a clear understanding of the subject matter and then going through it much more conceptually than algorithmically.

MPJ: Can you give us a model of how to teach math conceptually rather than algorithmically?

Dr. Schmidt: A U.S. lesson typically starts out with the algorithm. For instance, there is the example in the videos of a guy teaching geometry. He says to the kids, "Here are two supplementary angles, one is thirty, how much is the other?" A student says, "a hundred and fifty." And the teacher says "Good, now why is it that?" And her response is, "Because they are supplementary." Instead, conceptually, you could show them that if they measure a straight line, it's always one hundred and eighty degrees. Then they realize that if they put a line anywhere its going to cut it into two parts. That's conceptual; you start with understanding why, so if you forget the stupid name, supplementary, and you see a line with an angle you'll know what the other one is. That's the difference.

MPJ: How is a strong conceptual understanding of the mathematics developed among teachers?

Dr. Schmidt: It comes from two sources. In some countries, they must major in these fields. The other thing we don't think about is that they are products of their own systems. For instance, Japanese teachers don't necessarily take more mathematics at the university level than we do. But look at what they already know before going to the university. They are already ahead.

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MPJ: In regards to the things that our readership is looking at, active learning, projects, manipulatives, do you have any models from these other countries, or that you think could be done here?

Dr. Schmidt: You don't find very much of that anywhere else. They seem to be uniquely American inventions. Especially the cooperative learning. We asked teachers how much they use groups, and it's pretty much nonexistent. We are too much into the methodology in this country, and we miss the substance. We start talking about small groups and manipulatives and it just becomes process. Therefore, the substance behind it gets lost in the shuffle. And for a lot of these ill-prepared teachers, they grab onto this because that's what they understand.

MPJ: We hear that the US teachers assign more homework and spend more class time dealing with homework than the top achieving countries.

Dr. Schmidt: Yes. The dominate activities in the U.S. lessons were reviewing homework and doing seatwork. One thing that was startling is that the typical American lesson had only 10 minutes or less of instruction.

MPJ: What role does homework play in some other countries?

Dr. Schmidt: It varies a lot. Japan doesn't give a lot of homework, but the kids study for the next lesson. There's a difference, of course. Studying is what you do at the university, and homework is what you do in grade school. But Japan is unique. Worldwide, homework and seatwork are still the dominant activities. I think if you do that and you do it well, and develop the topics conceptually, it can work.

MPJ: Is this a curriculum issue instead?

Dr. Schmidt: It is the core issue, but just putting that in place by itself wouldn't work. You have to help teachers teach in ways that engage kids.

MPJ: So, that is something that teachers could start doing today. We could focus on engaging students and developing topics conceptually?

Dr. Schmidt: That is my point. We must start paying much more attention to the subject matter and teach it more conceptually and less algorithmically. And that is why we are in a catch-22. The Japanese teachers grew up in their system seeing math developed conceptually, no matter what they learned at the university level.

For our teachers it is a lot more difficult; they have to break out of a mold that they've been put into. But I think that is something that teachers can do - Get off the algorithmic side. Don't just give an equation and when a kid asks why, say "'Because that's the equation." Try to get them to understand what lies underneath some of this stuff.

MPJ: It seems that you are suggesting a lesson should move from concept to algorithm to application.

Dr. Schmidt: Not necessarily. A lot of the lessons that we've seen, like in France and such, start out with an application as a motivator. An example is a science one about transformers. They started out by looking at a map of the city and looking how electricity would flow. This got them hooked on the issue, then they hit them with some good hard science about the transformer.

That's very often how it happens: hook them with some kind of application, then take them into it conceptually, let them flounder - that's where I think what the Japanese do is a good idea - let them talk about some of their ideas, then give them an algorithm, a formula and a few examples. Whereas we typically start with the formula with a few sentences about it, and then have them do worksheets.

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MPJ: The report states that American textbooks cover too many topics, yet they typically have only fifteen chapters.

Dr. Schmidt: That is mistaking the notion of what a topic is. The definition of topic has to do with the substance of the mathematics, and when we define it that way, the measurement across all these topics is not how many chapters are in each book.

MPJ: Can you give us an example of four or five topics?

Dr. Schmidt: Congruence and similarity, three dimensional geometry, linear equations, and fractions. We actually tested 44 topics and determined how many of these topics were in any given textbook. Our 700 page books address about 35 topics. The Japanese, on the other hand, spend half of the eighth grade year on congruence and similarity alone, and their gain in that year is higher than in any other country.

The dilemma I have in telling you what to do is that the teacher shouldn't decide which five to ten topics should be studied in a year. It only works if somebody coherently lays this thing out as to what needs to be done.

MPJ: Do you have any last things to add.

Dr. Schmidt: People still think that there are general things a teacher should do, like cooperative learning. That's what people push. We push all the things that have nothing to do with subject matter. I'd like to challenge the notion that there is a single way to do things. If you listen to the ideological left, they say that there is only one way to teach. And the data just do not support that. Among the top achieving countries you cannot find one dominate way of teaching.

On the other hand, the ideological right are calling for "the basics." Yet, the latest analysis shows that the United States, through 8th grade, does average or above average in all the standard arithmetic skills. This is not the place were we are hurting the most. That is all we teach. That is what's wrong, we never go beyond the basics.

If I wanted to become rich and be an advisor to schools to jack their scores up, I know how to do it. We have certain areas of math that we have the international comparisons on. I can tell you the seven items that we are the weakest on, and if schools just did something in those areas, we'd go up in the international rankings. None of those areas is anything that we would consider the basics.

MPJ: What are those areas of weakness?

Dr. Schmidt: Measurement, error analysis, geometric shapes, perimeter, area and volume, congruence, similarity, vectors, geometric transformations, and three dimensional geometry. These are not the basics.

MPJ: Tomorrow, our readers will not be able to change the textbooks or create national standards. What can a teacher do in the classroom today that will model the type of change that you and the TIMSS report call for?

Dr. Schmidt: That's a tough question, because most of what I have argued is that, based on the data, these really are systemic issues. However, the data also shows that how we teach is as important as what we teach. Teachers should challenge students with more mathematical substance and develop the ideas more conceptually rather than algorithmically.