**Leaders in Mathematical Thinking**
Christine Suurtamm - Algebraic Thinking

>> So the presentation is on algebraic thinking and developing algebraic thinking. I think one of the key ideas is that algebra is not this isolated thing, that it is just about the manipulation of symbols. It really is about the way of us thinking about patterns and relationships, and being able to generalize them. And as well, it's not something -- people consider it abstract, but it's not really abstract. It really is about taking the thinking that we already have going on in our mind and sort of formalizing it and thinking about it with writing it with symbols. So I guess those are some of the key takeaways. I think that's really easy if we think about algebra in some of its broadest context. So, for instance, in the presentation, I'm building these large geometric structures, which actually represent algebraic ideas; so building X-squared and X-cubed, and 3X-cubed, and thinking about different ways that we actually could build them geometrically, and what, then, that actually means as we work with some of the symbolic ways of thinking about them. Or some other things I'll talk about that are connected to other strands are even building from number sense; so building the idea that students build number sentences in the lower grades. To think about developing what an equal sign means as they develop those number sentences, and then to extend that, then, to sentences that might have variables in them, which we would call an "equation." So it really is about thinking about how algebraic thinking, not just algebra as a set of symbols, but algebraic thinking is built throughout many of the things that we do. Oh, it looks like many things. It might look like students building. It might look like students -- heck, I even have students in a classroom working with a function machine; so they might be hiding inside what used to be a refrigerator box, but now it's a function machine. And we have two students inside who have created a function, like 2X plus 1, and we've got two students on the outside feeding this function machine a number, getting the output, and trying to figure out what the function is that's hidden inside the box. Could be students building structures with toothpicks, it could be working with algebra tiles. At older grades, it might be students creating graphs from walking around the classroom and discussing the different parameters and features of the graph based on what they do. So it's many things. And it really is about thinking algebraically in many different kinds of situations. So when they interact with math, they begin to own the math. They begin to see that actually, it's not math I might do at home or math I think about, and then there's school math. It really is about the math I think about as being connected to what we're doing at school. And what we're doing at school is connected to the way I'm going to think about mathematics. I find sometimes if all we do is show them how to do things, tell and explain, then they really actually don't make a connection. And so when they think about math as a set of procedures, that they have to remember and memorize, if they should forget, they have nothing whatsoever to fall back on. So if they've helped to develop some of their own strategies and explain their thinking, then they can connect to some of the more formal ideas. So for instance, in terms of solving rich tasks -- so one task that I use with students -- I actually use it with teachers quite a bit, too -- is what I call the "painted cube problem." So they take a cube that's made out of blocks, three by

three by three, and they dip it in paint. And the question is, so how many of the blocks have three sides with paint, no sides with paint, two sides with paint, one side with paint? And it's really actually hard to do that problem without building the cube. And as they start to build it, they start to notice patterns, because then we change it to be a four by four by four cube, and a five by five -- and it really starts to develop their spatial reasoning. But also, they start to make some generalizations, such as, hmm, I think that every time I make a new cube, I'll always have the same number of blocks that have three sides painted -- but I don't want to give away too many other relationships in there. And I guess the word is "own," the start to own the problem, because really, they walk away, they think about it, they come back to it, they discuss it with their peers.