Leaders in Mathematical Thinking
Connie Quadrini - Math Knowledge for Teaching

>> Some of the highlights from the session is, for those who are facilitating professional learning in mathematics, some of the real key things that we've noticed that makes us effective within our work is our own content knowledge. And in particular, more broadly, mathematics knowledge for teaching. That work allows us to be able to do a lot of anticipation, to do a lot of important planning. You know, where is a group at, where are they in terms of their own journey of developing their math knowledge for teaching? What kinds of activities or learning opportunities will I create or select in order to be able to support them, and going deeper within that development? It helps us to be able to bring in ideas together as people are sharing their thinking, not only about their own mathematics learning, but then what that means for students. Decisions that will be made in response to where students are mathematically and how to move them forward. So this has been one of the very key areas, but that has permeated amongst many of the other facilitation roles, as well as the actions and interactions. So Dr. Deborah Ball's research is fairly well-documented, and other researchers have built on that research. So she presents math knowledge for teaching as it's made up of subject matter knowledge, as well as pedagogical content knowledge. And within subject matter knowledge, we have common content knowledge, so kind of the everyday knowledge, what people would be using in their mathematics that they would be using within their everyday life, when it comes to baking, or being able to determine which roll of paper towels we want to buy today because it's the better buy. There's also Horizon Content Knowledge. So that ability to see how ideas kind of develop over the course of grades, how they're connected before the grade I teach, and now they're connected to how those ideas develop after the grade I teach. Specialize content knowledge -- and that's an important knowledge, and it's one we've been paying attention to provincially, the knowledge that we need that helps us to understand concepts quite deeply. For example, thinking about multiplication, two-digit multiplication, and being able to understand how something like 12 times 12 actually can be broken down into 10 plus 2, and 10 times 10 plus 2, and how that's made up of 100 and 20 and 20 and 4, and how those products come together to make 144. So that kind of knowledge is really important, because not only does it help us in planning for instruction, but it also helps us to be able to interpret what students create, their solutions, their mathematical thinking, and then giving us an opportunity to think of what to do to respond to that. There's also on the pedagogical side, so knowledge for content and teaching. And those are some of the instructional approaches we might take in order to have students learn about a particular concept, or an idea, a mathematical idea. There's also knowledge of content in students. So what are the typical things that students, for example, when it comes to learning about comparing fractions? What are the typical kinds of things that students struggle with when it comes to that particular concept, or that idea? Then, how do we help to anticipate or support that in light of understanding that about students, those typical kind of barriers or misconceptions, or partial understandings they might have? And finally, knowledge of content and curriculum

-- in the United States, they previously have thought about it through the lens of what the program is, so kind of how we would be supporting, teaching students through a particular program. Here in Ontario, we've been trying to think about that through the lens of our curriculum. So what is the intent of the curriculum, the mathematics curriculum? What are some of those important ideas? What underpins those ideas within the curriculum? What are some of the structural pieces around the curriculum, you know, how overalls connect to specific expectations? What are some of the references to learning tools, and how those support actually the development of concepts, and how those relate to skills and kind of procedural fluency? So these six domains are actually what make that math knowledge for teachers. So I think part of the work around supporting other facilitators around facilitating professional learning in mathematics, some of the things that I have think have been quite interesting, and I would say impactful is, again, our study of the mathematics; our kind of deepening our content knowledge. In particular, specialized content knowledge, Horizon Content Knowledge. And again, coming back to that idea that as we develop that specialized content knowledge, it's allowing us to think about the kind of questions we want to ask teachers, to push their thinking. It's supporting us, again, in being able to recognize what teachers create, and how to, again, have them think about the connections between their solution, say, and someone else's solution, and how ideas also again connect across the grades, and how ideas actually develop and become more sophisticated. So this has been helpful, because it's had us think about when students are struggling, and perhaps have some fragile understandings of particular concepts, or, for example, have gaps in their learning, part of that understanding is helping us think as educators, what are the kinds of things we're going to need to draw back on in order to pull forward, to help support them in terms of our differentiation or our response or remediation? I think these have been the kinds of things that have been very helpful not only for facilitators, because I think in terms of the content, that's been an important piece, because that's really what's going to help to move student learning forward. And the way they'll do that is through working with teachers. That's their job. But I think there's also a -- I think why that's been helpful for facilitators is because as they begin to deepen that understanding, they start to see the parallel about why it's important for teachers. So, in fact, it becomes a kind of a parallel journey or experience in having them think about how to develop that within teachers. And I would say that's been some of the most powerful, or most impactful learning, both at a facilitation level, as well as at a teacher level. So I think part of what's been most impactful for me as a facilitator, and I would say this takes me back a number of years, is one of the things that we learn around facilitation in general is that you're supposed to be neutral when it comes to being a facilitator, like your job is to facilitate the group, and that they will find their way, so to speak, whether you're working with an inquiry group, or you're supporting them in terms of identifying a problem of practice. But one of the things that I've certainly come to notice, and I think others as they've been learning around facilitating and mathematics professional learning, is that you can't always be neutral when it comes to mathematics. There are times when you're going to have to draw on your content knowledge in order to be able to support that group and bring attention to

something. And it has to be intentional and explicit. So I would say that's personally, for me, something that's been really important that I continue to develop and kind of refine. And I would say that for lots of the facilitators whom I've worked with -- and for teachers -- I would say that's also been that area that's been most impactful. It's as we think about the content, all of a sudden, it's affecting our thinking about assessment. It's affecting our thinking about development of learning goals. It's affecting our thinking about responding to student thinking. It's affecting our thinking around which tools we want to select and why, because we want to bring out particular mathematics. And I would say that's true, whether we're working to support facilitators or working to support teachers.