

Leaders in Mathematical Thinking

Connie Quadrini - Students with Learning Disabilities

>> I've been working in the area of supporting students with learning disabilities in mathematics probably for the past 10 or more years. And I've had a lot of wonderful opportunities to work around thinking about deepening my own math knowledge for teaching over the years, being able to think about how to support other educators in developing that. But I would say that the learning in that area, specifically for students with learning disabilities has been some of my greatest learning, not only because it's about a group of students who we know have average to above-average cognitive ability and yet are often not performing to the potential, their potential, academically. So certainly we know there's that moral imperative to respond to that. But in fact, in better understanding student profiles, the cognitive domains and processes, really kind of exploring that in a very deep way has actually helped me to better understand the mathematics and the kinds of things we can draw attention to when we're supporting educators and supporting students. To me, that exploration around better-understanding the cognitive domains, the cognitive processes, and then how that connects to the mathematics, and in particular, our development of mathematics knowledge for teaching. It's been that intersection and interaction between those that, to me, has had the most significant impact to me as a leader within the area. It's interesting, because a lot of my work has focused in the area of supporting students with learning disabilities in mathematics. And in Ontario, a few years back, we were learning about the impact of spatial reasoning, how it can support achievement in mathematics, how it's malleable. Students can develop it, and education plays a role in that. So that research was kind of coming out within Ontario, was becoming more prevalent, and we were learning more about it. And I was working in this area of supporting students with learning disabilities, and thinking about kind of the implications around some of those cognitive domains and processes. And one of the groups -- well, a few of the groups, in fact, that I was working with became very interested in spatial reasoning, in particular, how concrete and digital tools could support the development of spatial reasoning, could support the development of visualization, how that supported proportional reasoning, how that helped to support ideas about composing and decomposing. So that's been fairly -- that was fairly significant. And what ended up emerging from that is that we were finding that the use of those tools were supporting students not only who had strengths in visual spatial reasoning and fluid reasoning, for example, so it was tapping into those strengths and it was really allowing them to flourish in their learning, and really in their demonstration of learning. But even for those students who struggled in those areas, or who had a need in those areas, what that was doing, the tools, in fact, were supporting them within the development of spatial reasoning. So I think that was pretty exciting for us, to be able to think about the role that those tools would play in developing understanding of concepts, how that could support procedural fluency, and then what that meant in terms of next steps for us as educators around then going deeper into spatial reasoning. Like our groups in particular is focused on about seven aspects of spatial reasoning, including manipulating objects, comparing objects, the

role of composing and decomposing, visualization. Several of the groups that I was supporting within collaborative enquiry as a professional learning facilitator were working specifically in the area of supporting students with learning disabilities. And, in fact, what was happening is through the kind of exploration of the role of concrete and digital learning tools and how those would support students in understanding the concepts, what they came to understand is that students were developing their spatial reasoning, and, in fact, it was supporting students based on their cognitive profile. So for students who had a strength, for example, in visual, spatial or fluid reasoning, they were really seeing how those tools were helping to support the students in being able to develop understanding of concepts, and then actually show what they know through the use of those tools. And for students who had that as an area of need, they were noticing that that intentional work with the tools and drawing attention to specific parts of those representations were helping the students in developing that understanding of concepts, and then how that would then support them with developing fluency. So I think that those areas in particular were significant, not only for me as a facilitator of mathematics professional learning, but also for the teachers with whom I was working. So they could really see the connection between spatial reasoning, and how that was so significant to support students with learning disabilities. And, in fact, it wasn't just limited to visual, spatial and fluid reasoning. We saw students who struggle with processing speed, who struggle with working memory, and how the tools themselves were able to support many of those cognitive domains or areas of need, and served as kind of a way to support them. And so it's been pretty significant, you know? And I would say that another important aspect, I would say, of the learning has been around spatializing the mathematics curriculum, so being able to look at the mathematics curriculum and actually be able to see what's in there, you can look at through the lens of spatial reasoning. That's been pretty significant for our teachers. And the first basic thing has been just the use, the references to tools, like concrete and digital learning tools. How do those just give the opportunity to be able to develop spatial reasoning? How something like practicing visualization through some of what's in the curriculum, much of what's in the curriculum? Thinking about operations, being able to think about geometry in your mind. Picture it with your mind's eye. So it's been pretty exciting for teachers to kind of look at the curriculum with some new lenses, and be able to think about, well, what are those aspects of spatial reasoning that are naturally almost embedded, or have those strong connections within the curriculum? And then again, it's coming back to, then, what are the kinds of things that I need to be thinking about and learning about? And who can I learn that with? And what resources do I need to help me do that? So I think it's been a really wonderful opportunity for all of us to really think deeply about how that can support certainly students, always students, but then what that means for us as teachers and then leaders, and supporting that happening.