

Leaders in Mathematical Thinking

Cathy Bruce - Fractions Learning Pathway

>> So today, I'll be talking about fractions, teaching and learning. And it's a very complex area. We know that children experience significant challenge in this area. It's hard to teach, it's hard to learn. So we've tried to, in our research since 2011, get a better understanding of how to help students and teachers. And this includes a focus on unit fractions, something that's been relatively neglected in North America. It's used in other parts of the world, but it's an area that we can really pay attention to. So unit fractions are sort of one fifth, one third, one seventh, and so on. It really is the foundation of all-fractions understanding. If we give a sense of the unit fraction, then we can do other things with it, like compare fractions, add, subtract, multiply, divide those kinds of things. So that's one piece, a focus on unit fractions. Another key point is that we need to pay attention to the representations that we're using. So for example, linear models, number line style models, ribbons, rods, that kind of thing, seem to have longevity. They really go a long way, especially not just in sort of understanding or representing a basic fraction, like one half or one fourth. But when we get into larger concepts around comparing fractions -- comparing one fifth to one fourth -- then when we're using linear models, we can really see that. So it's a very powerful model. And we want to encourage people to use them, and discourage a bit of the use of circles. They're very difficult to partition, unless it is halves and fourths. And we prefer rectangular models that are easier to partition. We also encourage set models, and looking at both part-part and part-whole relationships there. So those are some of the key takeaways. Another important feature of the fractions work is to spread fractions throughout the year, so we're not just teaching fractions as a unit in, I don't know, October, or something. We're teaching fractions regularly throughout the school year, and not just as a discreet unit for fractions, but also connect it to number, to measurement, to geometry, to algebra, so on. And so across the strands is very important as well. Lack of conceptual understanding of what a fraction is, and over-memorization of rote algorithms, so when a student decides to invert and multiply, they may not understand exactly what's involved in that, or just even adding fifths. So I have five jugs of water, they each have a fifth of a container of water in them. If I add those together, lots of students will tell you that's five twentieths, rather than one and one fifth jugs of water. And so there's a lot of misconceptions around fractions. And it generally comes back to a lack of basic understanding of the principles of unit fractions, and comparing and equivalence. In our research since 2011, we've developed a comprehensive pathway, which tries to identify the core concepts that students need to learn and teachers need to teach, along the way in building a deep understanding of fractions. And behind that, a pathway -- we've developed tasks that match each of those stones or cells on the pathway. And we have video of students and their work, we have annotated work samples. So the idea is to build something that the teacher can go into. They can identify that their student may be having trouble of a certain idea, concept within fractions, and then go to the resources and see what's there to help them work that through with the students. Next steps there is, we've reached confidence through unit fractions, comparing and equivalence and addition and subtraction with

fractions. We haven't reached confidence with the cells or the steps on the pathway for multiplication and division of fractions, and so we're working on those right now, very heavily. But it takes a lot of time, because we work directly with students and directly with teachers, to make sure that it has classroom validity as well as research validity, in terms of assessments and those kinds of things. One of the things that we're interested in with our research is how fractions straddle all of the strands of mathematics, but also go across the whole curriculum. So if you think about foods and foods courses in grade nine, and cook instruction courses, that kind of things, there's so much use of fractions in those courses. And if we could get some collaboration going between the math teachers, the foods teachers, the construction teacher, the music teacher, then we might have some really good leverage in terms of making sure students really understand fractions deeply. This is very important for school success; fractions are an excellent predictor of that. But it's also important in careers. Think about medical dosages and the calculation of those dosages. This is an area where fractions calculations are used all the time, and can lead to lethal dosages of medication, and so on. So it's a matter of health safety and understanding in a whole bunch of areas of the world, of the curriculum, etc.