

Evelyn Lamb: [00:00](#) Welcome to the Lathisms podcast. I'm Evelyn Lamb. In each episode, we invite Hispanic or Latinx mathematician to talk about their experiences in mathematics. Today, I'm very happy to be talking with Hortensia Soto. Hi, how are you?

Hortensia Soto: [00:24](#) I'm doing great, Evelyn. Thanks for having me.

Evelyn Lamb: [00:27](#) So can you tell us a little bit about yourself?

Hortensia Soto: [00:29](#) Yes. I'm a professor of mathematics at the University of Northern Colorado, which is in Greeley, Colorado. It's northeast of Denver.

Evelyn Lamb: [00:38](#) I was looking at your CV and it seems like you've worked in Colorado most of your life. Did you grow up in Colorado?

Hortensia Soto: [00:48](#) No, I didn't. I was raised in Nebraska, in the panhandle of Nebraska, which is in western Nebraska, seven miles from the Nebraska, Wyoming borderline. And that's where I was raised.

Evelyn Lamb: [01:00](#) Oh wow. That's a pretty remote part of the state, I'd imagine.

Hortensia Soto: [01:05](#) It is. Yeah, it really is. It's very rural. And I guess I didn't think of it as remote growing up. I didn't know any different so I just thought this was normal.

Evelyn Lamb: [01:16](#) Yeah. So what were some of your early experiences with mathematics?

Hortensia Soto: [01:22](#) Yeah. There wasn't anything really too exciting in the early years, and mostly because I was trying to learn English. So we moved to the US when I was one and we only spoke Spanish at home, so school was really my first exposure to English and so I was struggling. And so thinking about the mathematics was not high on my list, but in fifth grade my teacher kept me in during lunch and had me do extra work, I wasn't sure why, but it turned out that she was keeping me in so she could get me caught up with the high group. And that was really a big turning point for me because then she walked me to the high class of math and I was scared, but I was amazed that I did understand it.

Hortensia Soto: [02:11](#) And then high school was another big turning point. I had the same high school math teacher the entire time, and he was really ahead of his time in terms of teaching. We always worked in groups, he lectured very little, we had to present ideas, we had to discover ideas. He didn't just do our standard exams as

part of assessments. Sometimes we had presentations as part of an assessment or an oral exam as part of an assessment. So he was just, I think, ahead of his time in terms of teaching and I really learned to be an independent learner. And I really liked that style of learning where I thought of it as play during class and then solidify ideas on my own.

Evelyn Lamb: [03:00](#) And what made you decide to pursue mathematics when you got to college and grad school?

Hortensia Soto: [03:06](#) Yeah. So all through high school my teacher was like, "Oh, you should pursue math," and I was not interested in that at all. I thought, what does one do with math? I didn't want to be a teacher. I didn't think I wanted to be a teacher, I should say that. I thought I was going to be a lawyer. I got to college, I took Calc I, and went and talked to my advisor and I said, "I'm signing up for Calc II," and he said, "Well, you've already satisfied your math requirement." And I said, "Well, we never even finished the book." And he just laughed at that and he said, "Don't you think you should be a math major?" Because he knew that I tutored and he knew that I was doing well in that, and I said, yeah. I mean, it was like so clear right at that moment.

Hortensia Soto: [03:51](#) My undergraduate advisor then, he was really, really amazing and very encouraging, and one day he said, "You should get a PhD," and I said, "What's a PhD?" I didn't even know what that was. And he told me, and I just really trusted in him and I just said, "Okay." It was just like I just knew this was what I was going to do because somebody that I trusted totally, that this is what I should do because I really trusted other people's judgments better than I did my own, I should say.

Evelyn Lamb: [04:28](#) And what college were you at?

Hortensia Soto: [04:30](#) I was at a small school in a shattered state, in Nebraska, western Nebraska, in the Northern Western part. So that's where I was at as a small teacher school.

Evelyn Lamb: [04:41](#) And sometimes that transition from college to grad school can be really rocky obviously. I know I experienced that. A lot of other people too. And I think especially coming from a smaller school, it might be difficult. How was it when you got to grad school?

Hortensia Soto: [04:58](#) A nightmare, is exactly like you said. I went into shock, I think. I remember thinking I'm no longer the cream of the crop. I didn't think I belonged in grad school. It seemed like everybody else

had these advanced classes that I hadn't had, they knew things I didn't know. I felt really behind where in high school and undergraduate I felt like I wasn't always the top, but I knew I was near the top. It was very, very, very difficult for me.

Evelyn Lamb: [05:38](#) And how did you manage to make it through?

Hortensia Soto: [05:41](#) Let me kind of back up a little bit here. So when I was at Chadron, I also got a master's in mathematics education and somehow, I don't know how I knew this, but I knew that I would get a PhD in math ed. Those were my goals. But I knew I needed a master's or that I wanted a master's in pure math first because I wanted my math to be solid and because I loved math. So I really wanted to be at a program where I could do both math and math education, and learn about that. And so at the first program that I went to where I thought I'd get my PhD in math ed, I didn't pass the qualifying exams for the PhD. I can't believe I'm saying that on a podcast, but I'm really glad I can say that, but I didn't pass them. Gosh, I just remember feeling like less than human at that time. But I just knew I had to get my PhD because I had told my undergrad advisor that I would, and I transferred to a different school and I was scared to death.

Hortensia Soto: [06:55](#) And I remember meeting with somebody at that school to go over my transcripts and the courses that I had to take in, and he asked me what books we had used at the previous school and the authors, and so I could rattle those off. And he just sat there in amazement and he said, "Oh my gosh, you have such a strong math background." And I hadn't heard anybody say that I was strong in anything for so long that he was just a breath of fresh air. And just somebody thinking that I actually knew something when I wasn't sure I knew anything anymore, that turned things around for me. I wasn't afraid. I was still insecure, I want to point that out. I was still very insecure, but I wasn't as scared about the math. All of a sudden I was like, "Well yeah, I know this stuff" and "Yeah, I can do this proof," and, "Oh no, I don't know how to do it, but let me tinker around with it. Let me play. Let me go on a walk. Let me talk to somebody about it." It was just back to how I used to learn mathematics, where I knew I wouldn't get the answer right away, but that I could play around and think about it and that something would come to me. So yeah, my confidence started to come back.

Evelyn Lamb: [08:22](#) So what is your research now?

Hortensia Soto: [08:25](#) So my research is on the teaching and learning of undergraduate mathematics, and currently I'm looking at the

teaching and learning of complex analysis and how one reasons about it geometrically. And so my work really lies at the intersection of mathematics, of cognition and education, of course. So I work through the lens of embodied cognition, which in layman's term means that we learn by doing, and generally that doing has a physical aspect to it, whether it's in the true life sense or it could be in the virtual world, so that means technological. And so in my work, I look at how students can develop a geometric reasoning about arithmetic or analytic concepts of complex analysis, and I use embodied cognition as a lens. And so that means that my sources of evidence are not just what do students say, not just what students write, but how are students conveying these ideas through their body. So gesture plays a big role as a source of evidence for me and my work.

Evelyn Lamb: [09:42](#) And so how do you do studies on that? Do you observe people working on complex analysis problems or talking with each other about the problems? I'm just curious about the logistics and set up of this kind of study.

Hortensia Soto: [09:59](#) Yeah. So generally, because gesture plays such a big role in my work, I bring students in and they might be working on a computer and then I get screenshots of all the mouse movements that way, and so that's how I can capture the gesture in that virtual world. But I also videotape them as I'm interviewing them. And so then I also look at their gestures that they might be doing out in the air where they might be mimicking what it is that they see. Or sometimes, they can't convey an idea verbally but their hand gestures are conveying the idea.

Evelyn Lamb: [10:37](#) So have you focused on complex analysis learning for a lot of your career or have you looked at a lot of different concepts?

Hortensia Soto: [10:47](#) Oh, I've looked at different concepts. And even right now, I have two big projects that I'm working on and they're not related at all, but they're still about teaching and learning. So it's all aimed at the undergraduate level and that's why I say it's a broad scope. So the context might change, but the big picture idea always is the same in terms of how do students reason about these concepts, whether it's proofs, whether it's about a particular topic, for example series, that was my dissertation, infinite series. And right now it's complex analysis mostly because I just fell in love with it.

Evelyn Lamb: [11:30](#) Oh, I love it too. It's my favorite subject.

- Hortensia Soto: [11:33](#) Oh my gosh, I just think it's so beautiful. And I remember when I was a grad student thinking, "Oh, I should do this for my dissertation," but I already had a topic and I was already almost done and I thought someday this is what I'm going to do, and 20 years later some day arrived. And I just love the work that I'm doing right now in that.
- Evelyn Lamb: [11:55](#) So I'm sure your struggles in your first PhD program did not feel like a helpful thing at the time, but I'm wondering if you feel like going through that experience has really helped you with the research that you do about learning math, understanding what it's like to feel so lost in math.
- Hortensia Soto: [12:15](#) Yes. I struggled so much there, but my "aha" moments just came later. I still have visions of me working on problems and I can see where I got stuck, and when I see where I got stuck ... I mean now I can see, "Oh, if I had done such and such I would have got there." Yes, it's made me more patient. And hearing my students say, "Oh, I just can't do this. I don't buy that," it's really helped me to learn about mindset a lot. And helping my students to develop a mindset, and to be encouraging, and to be helpful, and to be nurturing and to be compassionate, that's a big, big piece for me to be compassionate. But yeah, my struggles ... And I learned a lot of math there. I just didn't think I was learning anything.
- Evelyn Lamb: [13:15](#) So you've talked a lot about mentorship and encouragement earlier, when you were in school, how has that happened in your later career? And I assume now, 20 years out from your PhD or so, you also are a mentor to younger researchers and younger students coming in, so can you talk a little bit about the importance of mentorship in your career?
- Hortensia Soto: [13:43](#) A big yes. There's different pieces of our career and if you're in academics, we know that generally we're assessed for our teaching, for our scholarly work and for our service ... I mean, I'm grateful that I think I just learned to be a good teacher and I'm still learning to be a good teacher, but I think the fact that I am in math ed and I have literature to back up about what it is that I'm doing and why I'm doing it and just my own personal experiences ... So I don't feel like I've needed so much mentoring with that. And I needed help in terms of publishing because my writing was just not where it should be and I've had help with that. And that's people just sitting with me and helping me to write and restructure a sentence, and so I had mentoring in that.

Hortensia Soto: [14:43](#) But I want to talk in particular about the mentoring that I've gotten through the Mathematical Association of America (MAA) because I don't think I would be in this podcast if I weren't part of that community. I mean, I've been an MAA member since 1988 when my undergraduate advisor said, "You need to be a member of the MAA" and again, I just said, "Okay." I just did whatever he said. And so the MAA, people in the MAA, have been huge, huge, huge mentors for me. They, again, it's like they saw something that I didn't know existed. Jim Leitzel and Chris Stevens, who gave me the first opportunity through project Next to begin to facilitate sessions, I'm thinking, "Why are they asking me? I am like, nobody. I am the person who failed their qualifying exams." I was just dumbfounded that I'm being asked to do these things. Jim Daniel, who nominates me for things routinely and who just believes in me, Martha Seagull, was on my first board of governors, and she just started giving me more and more roles in the MAA and assigning me to committees. And again, I'm asking myself, "I don't know anything about this, why are they asking me to be on this?" And I kept saying yes.

Hortensia Soto: [16:11](#) And they just have nurtured me and prepped me to be a leader and taught me how to be a leader, and I don't know what I would do without that community. That really is my professional community. And they're the people I look up to the most, they're the people that I seek out when I need help with something and just advice about my career, if I'm getting ready to transition into something new, whether I should do it, whether I shouldn't do it, the travel that entails when I get invited to do things, how to balance those things. Yeah, I've had great, great mentors my entire life and they helped me in all sorts of ways, in academics, and my personal life. And I'm really grateful to them.

Evelyn Lamb: [17:04](#) And finally, what are your thoughts about Hispanic heritage month and other things like that that specifically look at the Hispanic and Latinx community?

Hortensia Soto: [17:18](#) That was the hardest question for me to think about, and as I reflect on it more, I think it's really a time, a month, an opportunity for us to remember and to applaud and to pay tribute to those who sacrificed so that we even have a chance to try to contribute in a meaningful way. So, I mean, for me, I think about my dad who has a third grade education and my mom who has a third grade education, and that I wouldn't be here if it weren't for all the sacrifices that they went through.

- Evelyn Lamb: [18:00](#) Well, thanks so much for taking the time to talk to me today.
- Hortensia Soto: [18:04](#) Thank you, Evelyn. I really appreciate you asking me to do this. It means a great deal.
- Evelyn Lamb: [18:12](#) Thank you for listening to the Lathisms podcast. It's produced by me, Evelyn Lamb, and made possible by a Tensor SUMMA grant from the Mathematical Association of America. Our music is Volvere by La Floresta. Lathisms is an initiative to celebrate the accomplishments of Hispanic and Latinx mathematicians. It was founded in 2016 by Alexander Diaz-Lopez, Pamela Harris, Alicia Prieto-Langarica, and Gabriel Sosa. You can find more information about the project at lathisms.org. That's L-A-T-H-I-S-M-S-O-R-G. Join us next time to hear from another inspiring mathematician.