

Mark Royce ([00:00](#)):

First of all before we dig in too far, I want to ask you to tell us a little bit about your science background. How you got involved in, you know, kind of a little of your history there.

Chance Hoellwarth ([00:13](#)):

So I actually graduated from college with a physics degree, thought I wanted to be a high school teacher and ended up going to graduate school because I didn't feel quite ready. And so then at graduate school, things changed and I came to Cal Poly as a lecturer. And so that kind of put me involved in sort of physics education research, as well as teacher preparation, just cause I had a real interest in sort of the high school teaching and that's sort of where I am now and then as I was at Cal Poly. So I guess I didn't tell you, I got a PhD at UC Davis. And that's where I got exposed through Wendell Potter into some of the physics education research and really kinda pushed me into that pathway and definitely coming to Cal Poly, which is a primarily teaching or certainly was a primarily teaching institution really made physics education a lot easier to do than low-temperature physics, which I had done before where, you know, we had magnetometers and things that were called 365 days a year, 24 hours a day. That was a lot harder to do at Cal Poly. So that's sort of how I ended up in sort of the physics education/teacher preparation. And then about 20 years ago that university really had a push into, you know, wanting to produce more teachers. And so they developed the center is now directing the Center for Engineering, Science and Math Education, which was really about more and better-prepared science and math teachers and more diverse STEM professionals. So we do a lot of stuff with trying to get undergraduates experiences with teaching and trying to do professional development with teachers to kind of improve instruction.

Mark Royce ([02:05](#)):

So you went from wanting to be a high school teacher to getting more involved with teacher development at the university level. What drove that passion?

Chance Hoellwarth ([02:14](#)):

Yeah, I think, like I said, I did low-temperature physics and when I came to Cal Poly, I was doing a lot still partnering with UC Davis, but I really had a passion for education that I'd kind of been exposed to physics education. And even though I did well, I realized there were probably other ways that you can teach physics that might be more engaging. And, actually, I mean, I probably got involved in teacher prep because at that time Cal poly was hiring a lot of people and you know, I met someone at a social gathering. She's like, we need more people in physics in teacher education. And so you should come to these meetings and do this. And so, I mean, I was a young person trying to find my place at Cal poly. So I did a lot of different things, you know, the research, traditional physics, education research, this teacher prep stuff. And sorta, I have been doing that for as long as I've been at Cal Poly now, so

Mark Royce ([03:10](#)):

Which is how long, how long have you been there?

New Speaker ([03:12](#)):

I think about 23 years.

Mark Royce ([03:14](#)):

Okay. So how did you get connected or introduced to modeling instruction?

Chance Hoellwarth (03:21):

You know, that's great. I think I went to the American Association of Physics Teachers in San Antonio, Texas, which must have been 22 years ago or something. And I remember hearing about modeling and it just sounded like the kind of thing. Like I didn't know what it was. And I was like, Oh, that sounds like the kind of thing I think we should be doing in physics. And so there were workshops there, and I still didn't have a really good handle on what it was. And so it kind of sat there in the back of my mind, you know, kind of as a question, what is modeling? What is this thing? And then when I became the center director, we were really looking for different things that could help. And so, we actually went there, the guy that I was coach John Keller and I were co-directing the center. We both at different summers, went to a workshop at ASU and sort of experienced model. And we both came back and were like, this is great. This is the kind of thing that we should be doing with teachers.

Mark Royce (04:24):

So what are the benefits that you see in modeling instruction that help teachers reach their students?

Chance Hoellwarth (04:32):

Well, I think one is, is just I mean the thing that I walked away from this first workshop was just the focus on language. Right. And I realized how much I didn't pay attention to the words that I used. And wasn't really explicit with the words I used. And I can't remember the person that was the instructor, but, you know, he talked about words and you know, when we talk about graphs, you know where you said, Hey, the slope is up or the, or the graph goes up, he's like the graph doesn't go anywhere. The graphs just here, right. We need to be more precise and say the slope of the velocity versus time graph is positive. Right? Like those are things that otherwise, how does everybody know what you're talking about? So that was the first thing was sort of this like, Oh, like if we could pay attention more to this language, that would probably make things cleaner for a lot of people.

Chance Hoellwarth (05:24):

And I think then just the focus on interpreting the graphs, I think was the second thing, like, just that, Oh, we're gonna, we're gonna build this sort of understanding from things that we've done, I think is really powerful for students. So then that was the second thing. And then the thing that I walked away later is just that there's this whole network. Like, I didn't appreciate this at the beginning, but it's that the modeling network where you have all these modeling teachers that are helping each other support themselves. So from this sort of center perspective was like, that's a big. Just think that like the center can help every teacher in California or wherever, and you really have to be involved in that stuff. Day-To-Day, cause I mean, fine. I understand. And I can totally appreciate the value of modeling, but what it means to implement it on a day to day level. And what are the things that you do to keep kids engaged like that I haven't done. Right. And so having that network out there where people can, you know, find people that are at their same level, find people that are more advanced, so that can really get help doing stuff. I think that is super powerful.

Mark Royce (06:32):

Wow. So running the center at Cal Poly, what are some of the challenges at that level for creating a professional development through K through 12 teachers? Because is that who you guys work with?

Chance Hoellwarth (06:49):

Yeah. That was sort of our vision was sorta like, Hey, you know, partly we had this teacher preparation hat on, Hey, we want to have teachers out there that we can place physics students with. So they're there, they're seeing the kinds of teaching that we'd really like to see in classrooms. So how do we help people do that? And so that sorta was our initial sort of thinking about, you know, focusing on professional development because if we have teachers and we put physics teachers there and they see this stuff, then they're more likely to do the things that they see. And then that's a positive sort of self-fulfilling kind of cycle. So that's sort of what we were thinking about now, but did I lose your question in there?

Mark Royce (07:26):

Well, I just was wondering what kind of challenges you've run up against in doing that at the university level.

Chance Hoellwarth (07:32):

So the challenge, right? Like, so we can offer stuff in the summer. That's not really, I mean, people will come, but I think finding things that are really valuable that's enough that teachers can go back and implement. I think that's the, maybe the other thing about the modeling instruction is that there's at least a framework that you can pull activities and things and you still have to put them together in the way that you're going to make them work and adapt to your students. But there's a structure there that you can go pull and go, Oh no, I can pull that activity. Or I can modify that activity, which is a lot easier than going back and say, Hey, we've got this great idea that you should use models to do physics, but you're going to have to figure out every one of them, when you go back to your classroom, like that's just really not going to work that well.

Chance Hoellwarth (08:17):

And so I think the challenge is finding that balance. Cause we certainly do some where we bring teachers in and we try and do that, but really trying to connect with people during the school year so that you're engaging with them. That's, that's just hard. It's hard for teachers to find that time. It's hard for us to find that time and then have it be really valuable at the same time. And we have a lot of local teachers and we're trying to explore, you know, how we do this. So we have some local physics teachers and we get together, you know, typically two times a year. And once in the summer and with the pandemic, we've kind of tried to meet, you know, every month or every other month just to kind of stay in tune. But you know, it's a challenge, right. Everybody's busy. So trying to find the thing that's really like, like valuable. Yeah. That's hard to do. To change everybody's what they're doing. They need, they need to kind of roll with where they're at and people can do little changes, but doing big changes, you need more support. So we're still, we're still exploring. Yeah.

Mark Royce (09:16):

Yeah. I know your background is physics and you guys started with modeling instruction for physics teachers, but you've expanded beyond that. I believe not just physics in your workshops.

Chance Hoellwarth (09:29):

Absolutely. I mean, look, if we could, we would do physics, chemistry, biology all the time. So we really started with physics cause that's sort of what we knew and, but, but actually the first workshop I was actually gone on sabbatical and John brought in some people and really did a holistic modeling, right. It

was like a one week I think maybe it was two weeks, but it was a little physics, a little chemistry, a little biology, a little earth science kind of thing. And that was sort of the first one. And then we did physics. We found a physics instructor and really did that. And then pretty quickly we rolled into trying to do chemistry and trying to do biology. So there were a few years where we ran a physics and chemistry and biology. And I think there's a lot of people that are really interested in biology, but there haven't -- at least back then there weren't as many biology instructors. So it was hard to find. And so I think we were just on track to really get it going. And then the pandemic happened last summer and everything had to kind of go online. So we lost that. So hopefully this summer we'll have a biology modeling at Cal Poly and whether it's online or in person, we'll see.

Mark Royce ([10:44](#)):

That's a growing area. I know there's been a lot of development in the biology focus for modeling instruction recently in the last couple of years, especially. So what are you hearing from teachers who are going through your workshops like your summer workshops? And I assume you kind of stay in touch with some of those teachers. A lot of them are probably from the central coast of California. And what are you hearing from them?

Chance Hoellwarth ([11:15](#)):

Well, actually, most of our teachers, I mean, because modeling has such a big network, we get a lot of people from all over. And so if we're lucky we get half from local, right. We're a very small region. So, you know, once people come, once they come, they don't come again necessarily unless we offer sort of the second quarter, but by and large people do come again. They're the people that, what we hear from teachers is, I mean, they find the workshops really valuable, I think, because they can see how practical it is. They get all those free resources. I think it really opens their eyes to sort of using the data that drive why and the relationships between different things, whether that's position and velocity or velocity and acceleration or what are all the other things that happen. So I think they value sort of that pragmatic... And I think there's this language piece built in. I don't know. I'm not sure anybody has sort of said that exactly. But really all of those paying attention to what we really mean by all of these different words, how are we going to interpret the graphs? I think that just kinda comes with the program, but I think they find the connections. Like I think people really, I mean, they may even may have 15 or 20 people in there and they certainly won't connect with all 15, but they're certainly there tend to be groups. It seems like it really kind of connect, you know, probably wherever they get put in these groups. And then they're like, yeah. And then those people talk to each other, you know, outside of the, the workshop. Yeah. And certainly people want to come back like physics, we have three possibility, you know, there's some mechanics and then there's sort of the waves and then there's electricity and magnetism.

Chance Hoellwarth ([12:55](#)):

And so, I mean, people want to come back and do them. So I think it's been a super positive for the local environment. I mean, we have just hired a bunch of new physics teachers, so we're definitely trying to, you know, get a few more in here. So we have more people doing modeling. Cause I think that'll just help everybody be sort of more on the same page. So then you can actually leverage each other a little bit more where if you're doing your thing and I'm doing my thing and someone else is doing modeling, it's hard to have conversations and say, Hey, you're thing can help me and my thing can help you. So yeah.

Mark Royce ([13:31](#)):

So you've been doing these workshops at Cal Poly for about a decade now, right?

New Speaker ([13:37](#)):

Yeah. Oh, absolutely.

Mark Royce ([13:39](#)):

Yeah. So what have you found to be the most satisfying for you personally and professionally in hosting these workshops? I'm curious about how it's impacted you personally,

Chance Hoellwarth ([13:54](#)):

It's affected me personally. Just, I mean, it's just great to see these teachers here and seeing them build their community and, you know, get involved with modeling. I mean, I think it's great if I were teaching high school I'd jump into modeling and, you know, do that if I could. And I think it's been very nice. I mean, we've had some instructors that have come in here and been very consistent. So, you know, Brenda Royce has done chemistry. John Anderson has done physics for most of those 10 years. I think it's cool to see those people every summer and kind of interact with them and kind of see what's happening in their worlds when they're really doing the modeling teaching and, you know, see them interact with all the teachers. And I haven't been as big a part as I like, right. I get caught up in lots of things in the summer and everything seems to hit all at one time. I mean, I'd love to go hang out there and see what the teachers are doing, but I haven't actually a whole as much of that as I would, like,

Mark Royce ([14:54](#)):

I know you have a strong involvement with the Noyce Scholars program. First of all, can you share what that is? You know, cause not everybody listening may know about Noyce, probably some do, but, but kind of describe to us what Noyce is all about.

Chance Hoellwarth ([15:12](#)):

So Noyce is about really giving. I mean, it's a lot of it is about giving scholarships to students and those scholarships are sort of really a loan. They'll give you \$10,000 or \$15,000 a year if you commit to teaching in a high-needs district for two or three years. And so that's sort of the basic structure, but in addition to that, they have a structure where, you know, they'll meet once a month and kind of talk about what's it mean to teach physics or biology or chemistry in a high-needs school district? Like what else do you have to think about other than physics, chemistry and biology. And so we've added a really solid team of science educators and a woman from ethnic studies who studied science and technology. And so they work with them and really sort of build the connections with those students. But actually, I mean, that's, what's made our modeling workshops viable is that we've had Western regional Noyce. We've really, they've contracted us to put on these workshops the last few years for Noyce scholars

Mark Royce ([16:17](#)):

Specifically have chosen to link the Noyce scholars to the modeling workshops. Is that correct?

Chance Hoellwarth ([16:24](#)):

Right. Well, so the Western regional Noyce has put a proposal and said, Hey, we want to do they contract with NSF to do certain work. We're going to do PD in the summer. We're going to put on workshops during the year. We're going to, there's a national workshop in Washington DC. And so we

contract with sort of the PI, which is San Francisco State. And we do the modeling science and they, they partner with Northern Arizona university to do something similar in mathematics. And so that's sort of, they've decided, so we convinced the Western region on the, you know, the PI think John Keller was one of the co-PI's and said, Hey, we should do modeling. And that's sort of how we, so we got involved in the last few years, right? And so what we're trying to do is figure out how can we sustain this once Western regional Noyce goes away, right?

Chance Hoellwarth ([17:12](#)):

Because what's happened is we have some money from Western regional Noyce and we have some money other money. And then that's what allows us to offer physics and chemistry. And so half the spots are for Noyce scholars, but half the spots can be for other people as well. And so if some of those people are local and we have money to support those people and then other people just pay to come to the workshops. And so on the whole we've been able to sort of make that work, but with the eye towards what happens when Western regional Noyce goes away, we still want to be able to do all these workshops. So where's the price point that allows people to come. People are willing come and we can still, you know, pay the instructors and have people put people up in rooms and all that stuff.

Mark Royce ([17:58](#)):

That admin side of your job is probably pretty demanding, I would guess you know, running these workshops or do you have a team around you?

Chance Hoellwarth ([18:08](#)):

I have a team? So, I mean, it's not so much, I mean, there's certain times where you have to think about things and we've had really good people that have picked up the details and handled advertising and, and handle all the questions coming from people because yeah, if I had to answer all the questions that people are interested in, then that would definitely be a different job. But that's what it takes. Right. I mean, administration certainly it's different than teaching. Everything's got its pros and cons, you know, and on different days, every other one looks good and others look bad. So we're cruising along.

Mark Royce ([18:42](#)):

So I'm curious about the modeling instruction philosophy. Have you seen it or has it had an impact on the teaching at Cal Poly's science programs or education programs? And do you see an influence?

Chance Hoellwarth ([19:02](#)):

Mo, it's pretty isolated. So, about 10 years ago when I was super excited, I tried to teach modeling one quarter in it. Well, I did teach modeling one quarter in that at the university. And that was sort of before I got really pulled into administration and, and I think it could work. I think it could be valuable. But then we had to think about some things only seeing people for that littleer time. Where in high school you sort of see people, you know, every day for an hour or a couple of hours for two days where this 10 weeks, you know, only having 30 hours definitely sort of limited what you can do. You needed more supports to have people do more stuff outside of class that I was not set up to do because it seemed like you'd come in and you go, no, the important thing is to do the experiment.

Chance Hoellwarth ([19:55](#)):

Well, that's great. But then, you also need to help people scaffold and understand how you're going to take the slope and what that means and, and figure out, you know, how you're going to represent that

as an equation. And if you don't do all that, then students really feel like I didn't, you didn't give me enough of what I needed. Right. And they don't appreciate the lab where I think if you can kind of do all those things, Hey, we did this experience where we kind of understand what's going on with this experience. And we've kind of developed all the representations and we had time, it just made it really fast. You're like, okay, this 15 minutes, we're doing this, this 15 minutes doing this, which is sort of counter productive at some level, if you want people to feel comfortable. And so, like I said, I think you could figure it out and make it work in higher ed. But you have to think about it -- just a structure which I think teachers have to do if they're in block schedule or not block schedule that there's some things to figure out. So does that address your question?

Mark Royce ([20:54](#)):

Yeah, it's interesting. I was wondering if modeling approach in the classroom would work well in a university setting or not? You know,

Chance Hoellwarth ([21:04](#)):

I think, like I said, I think it could, I think like unfortunately at Cal poly, you know, in the meantime there've been lots of budget cuts. People have cut the lab section from our mechanics courses, which makes it a little bit harder. So now you have even less time to do all the stuff. But it can certainly work. I mean, if you have to teach 150 people, you'd have to think a little more, but i'm positive you can figure out how to make that work because I think it's great. I mean, it's just the problem. I think for a lot of university faculty, they come in and it's just, it just seems slower. Right? Cause you're kind of spending this time, which I think is super important. Right? You got to understand these things. You can't just kind of go up there and go, Hey, this is how it works and expect everybody to come along, but it's a harder sell and sort of what happens in the summer when we do this PD is, you know, we don't really interact with the faculty that are here. So it's not like there's a crosstalk. Right. I see. And there's only so many things you can, like, I think you can do that. You can try and make that happen, but there's only so many things you can do in a 24 hour period. So you gotta make choices

Mark Royce ([22:17](#)):

If someone's listening and they're interested in participating in one of your workshops, what's the best way for somebody to get connected to Cal Poly?

Chance Hoellwarth ([22:28](#)):

Absolutely. So typically when we do workshops there, they get advertised on the AMTA website and all that. And I mean, we'll have our own website, but it certainly doesn't... I mean, you could come to Cal Poly, you could come to our Center for Engineering, Science and Math Education, which we call CESAME's webpage and we'd have links on there to it. But certainly the easiest access is through the AMTA.

Mark Royce ([22:52](#)):

I'm just curious about, from your perspective, I'm gonna ask you to pull out your crystal ball and look at what do you see coming in the future, what's on the horizon in science education that you think could be a real positive and improve the effectiveness of science education in our schools?

Chance Hoellwarth ([23:15](#)):

Well, I don't know, maybe this isn't my crystal ball or my hope ball or whatever, but I think this sort of paying attention to inclusivity. Right. And how do people feel when they're taking courses and trying to... Like we have an under-representation problem, right? There are very few Blacks, very few Latinas, Latinos in the field. Right. And we're not women, I mean, physics isn't in particular. Isn't that good? So how do we sort of create and think about what's the culture that we're creating in our classrooms? I don't know. I think modeling sort of did this default, but I think you could even be more explicit about supporting people, supporting, you know, giving people counter- narratives to the narratives that are out there that are telling people, look, women and underrepresented people don't belong in physics and really paying attention to language, you know, and, and saying, Hey, how do we sort of value what people bring and teach people sort of the language that we're using? Because I think there's a whole dynamic in there that I'm just starting to understand. So that would be my hope is that paying attention to the culture of our classrooms will then sort of help drive more people interest in physics, you know, as well as keep the people that are interested, that started interested in, you know, people that then just felt like they didn't belong and sort of ended up leaving. So I mean that mostly, I guess I'm wearing my physics hat, but I think it's true in science in general as well.

Mark Royce ([24:45](#)):

So how do you think we do that? How do we promote that broader inclusiveness, to bring more of the outliers into the education arena?

Chance Hoellwarth ([25:00](#)):

I just read a book by I think it was Bryan Brown STEM in the city and he talks a lot about language, both as a language defines who you are and language sort of defines who's in the discipline. So really listening to students cause he had done some workshop or he had done some study where he coached baseball and just try to understand what do baseball players know about throwing curve balls and one of his things that he talks about is that they understand a lot of stuff, but when they describe it, they don't describe it the way that you would describe it in a physics class. And so making sure that you don't throw out what they know, because they don't say it in the way that you think it should be said, right. You have to pay attention to that point where no, what are they really trying to say? And what do they really understand? And then how do we translate that into the academic language that we really want students to use if they're going to do a physics sort of explanation and sort of valuing that? Not because I think what happens a lot of times is people get shut out. You know, they're like, Oh no, that's not the right language. When really there was understanding in there. Maybe not the full understanding, maybe not everything, but certainly there were pieces in there where people understood what was going on or an idea, or at least that idea could be a scaffold for someone else or a resource for someone else. And so I think that's one thing as well, and then giving people a chance to practice their academic language. And the other thing is this ambitious science teaching, which think can go really well with modeling, which really puts this like modeling puts This focus on phenomena, right?

Chance Hoellwarth ([26:49](#)):

That's the thing. And then linking those phenomenon to things that people care about, right. Or at least can draw them in, right. I mean, what's the story in there. And I think, you know, a cart moving down the track, isn't the most interesting story, but it's at least more relevant than a lot of other things, you know, if you didn't talk about it. And I think you could, if we work a little harder, find things to talk about and really find, what do people know and get their language pieces out there and really do like the modeling thing to really develop their understanding. I think that, and I think in that process, if we're really listening to people and we're connecting to what we think is really important, then I think, I think

some of that can happen as well as being explicit. Right? I mean the whole George Floyd movement, we need to be more explicit about how do we create these environments? How do we include people? How do we educate ourselves in that regard? And all I can say is, yeah, we need to be more explicit. I don't actually know how to do all of that at this point.

Mark Royce ([27:49](#)):

Well, the process is, is the challenge in how to get there. So what is it about modeling that you feel is, is really important for our classrooms in America?

Chance Hoellwarth ([28:03](#)):

I think what's really important is that, it's putting the focus on students, so structurally you're sort of having them and you're putting the focus on phenomena. So they are trying to describe phenomena, which is really what science is about. Right. It's not about having the right answer or doing this. It's about trying to explain things that we see around us or make sense of sort of the world, you know, and so really putting that scientific enterprise and valuing, like I don't know that everything has to be phenomena, make sense of it, do all that. Right. But you need to do that a few times. So you appreciate the process and really can kind of connect with it. And so I think that's sort of, what's valued. And I think related to some of the other things we said about focusing on language and all that, I think the structure is there for modeling.

Chance Hoellwarth ([28:55](#)):

So I think it's an easier transition to really start to pay attention to, Hey, what's the environment, you know, what are we trying to do? How are we want people to feel in this classroom? Like, I think that was already there and with, you know, it's, so it's easier to even up that game, I think a little bit more. So I think that's the real, like for me, it's sort of that the phenomenon piece, because I think that's just so much and really trying to make sense of that through the models. I mean, that's what we mean by the critical thinking in science and having an appreciation for all those things.

Mark Royce ([29:24](#)):

So yeah. And teaching our students how to learn.

Chance Hoellwarth ([29:30](#)):

Right. Absolutely. You know, they have to bring their critical thinking. I mean, you have to put people in position where they have to do it and they have to want to do it. Right. I mean, it has to be engaging enough that people, I mean, otherwise, I mean, you can have the greatest thing in the world and people don't come along, then they're not going to get what you wanted. And so I think that's what I think that phenomenon can really pull people in and they're going, Oh, well I don't really care, but you put this thing in front of me and now I want to understand what it's about. Right?

Mark Royce ([29:59](#)):

Yes. That was great. Well, Dr. Hallworth, I'm grateful that you took the time to talk today.

Chance Hoellwarth ([30:09](#)):

My pleasure.

Mark Royce ([30:10](#)):

It's been great chatting with you. Let's connect another time.

Chance Hoellwarth ([30:13](#)):

All right. Sounds good.