Mark Royce (00:01):

Hi, Kathy. How are you doing?

Kathy Malone (00:03):

Oh, hi, doing fine. How are you?

Mark Royce (00:06):

I'm good, thanks. I'm excited to talk to you today about all the experiences around modeling that you've had. As I looked into what you've been about over the years, it's been really fascinating to see how your research has unfolded and all the research that you've done. I was blown away when I saw that you had published 69 articles or something.

Kathy Malone (00:32):

Is it that much?

Mark Royce (00:33):

Yeah. You gave me a link to a website called ResearchGate.

Kathy Malone (00:41):

Ah, yeah. Yeah.

Mark Royce (00:42):

And I was blown away by all the stuff you'd been involved with. And so we'll talk a little bit about that in our conversation today. Your profile was really fascinating to me, the quantity and the quality of the research papers. I read a few, I read all the titles and read a couple of the, the posts. It was very cool.

Kathy Malone (01:03):

Well, thank you very much.

Mark Royce (01:05):

So yeah, I'm happy to have found out about you. I think we'll start out with me just asking you, how did you first get introduced to the idea of modeling? I know you took a workshop several years ago.

Kathy Malone (01:25):

Yeah.

Mark Royce (01:25):

Was it '98 or something?

Kathy Malone (01:27):

I can't remember. It was, um, 1995.

Mark Royce (01:32):

Yeah,

Kathy Malone (01:33):

1995. So, Larry Dukerich was the lead on it.

Mark Royce (01:39):

Mm-hmm. <affirmative>

Kathy Malone (01:40):

And Jeff Steiner, I think, was the co-lead. So it was the first initial one from their initial NSF grant that Hestenes wrote, back in the day. So at the time, I was a high school teacher, teaching physics in Pennsylvania. So I had seen the article by Hestenes, I think at the time and Wells that showed that he had a lot of large increase in his FCI scores. 'cause I was always wondering, I was using inquiry-oriented methods and projects and et cetera. And students just did not do well on the FCI, post-test-wise. So there wasn't a whole bunch of gain, small amounts, but not a whole bunch. So when that opportunity came up for the modeling, it was like, oh, maybe I should see what this is all about, you know, and see if there's anything different going on there. So that's why I did that. Yeah. So it was a five-week workshop, three summers. Five, actually the third summer, I think they, they squashed it down from five to like two or something like that.

Mark Royce (02:57):

Yeah. It's actually, I think, recently been more-- it's about a two-week workshop. Yeah. Some follow up, a little bit of follow up, and they're trying to figure out ways to give teachers a little more, but it's hard, you know, teachers are busy.

Kathy Malone (03:11):

Yeah, they are.

Mark Royce (03:12):

It's hard for them to get away for workshops, you know? And especially when they lost the funding from the NSF.

Kathy Malone (03:21):

Yep.

Mark Royce (03:21):

Yeah. So, so you were teaching physics at that time?

Kathy Malone (03:27):

Yes. Mm-hmm.

Mark Royce (03:28):

<affirmative>, talk to me a little bit about how the workshop changed your approach in the classroom.

Kathy Malone (03:34):

Well, actually, what was kind of interesting, initially it was just a tweaking of sorts because modeling is an inquiry-based, constructivist-oriented practice anyway. And that's what I had been doing. But what modeling did, was showed that just because we can see links between representations and we can see the representations, if we're not explicit about that with the students. And help guide the students into making those connections between the representations. They don't see it, as novices normally do, they just don't see it. Because most of the labs at that time, I haven't really looked at the newest, I know they're always updating the curriculum, so I haven't looked at the newest one 'cause I'm not teaching in high school, currently. But the labs were very basic labs that most people had already done. Right. And I think that was on purpose, to make people feel comfortable because it's like, oh, I've already done this lab.

Kathy Malone (04:40):

And so now we're talking about doing this other stuff in addition to the lab, and it was like, okay, so that makes sense. So yeah. So I was kind of a quite surprised by seeing how my students interacted with that information once they started making aha moments in class, even as they were writing about it in their journals or talking about it in front of class. And there was like, you'd ask a question like, how do you know that? And it'd be like, oh, well, you know, 'cause this, well, and then halfway in between, they would say, what, wait a second, that's wrong, because that has to connect to this graph over here. And it's what I'm just saying, just didn't, so that must mean that, oh, this is happening at this point. You know? So, yeah. So that's the main focus that I saw that was different about modeling.

Kathy Malone (05:29):

And being able to talk about physics in terms of big ideas, which at the time is what my school, I think, was doing, big ideas. And that's basically what a model is. It's a big idea. Right? So it's basically the goal at the end, right. That you would know what this model is, what these representations are, and that you could then go ahead and use that in many different contexts. Right? Over the years, it's interesting how that has changed, but initially that's what it was. And I saw big gains in my FCI scores the very first year. And, you know, they continued on after that. And I noticed as David Hestenes told me once, I said, oh, man, these FCI scores went really down. And he said, well, what happened last year?

Kathy Malone (06:12):

And I said, oh, well, you know, this happened. Like my daughter was diagnosed with type one diabetes and whatever. He said, ah, he said, so, um, you were kind of busy with lots of other stuff. And I said, yeah. He said, oh, so you probably dropped the ball in a couple places. And I said, you're probably right. You know, because you can only do so much. And task orientation is a little bit different sometimes when family and everything else comes into play. Sure. 'Cause the devil's in the details, you know, the devil's in the details.

Mark Royce (06:40):

Absolutely. What would you say-- you've been doing this for a long time, but before you were teaching using modeling methodologies, is there something that you wish you would've known before you got introduced to modeling and discovered it?

Kathy Malone (07:00):

I think, the whole idea of novice and experts and how experts go about teaching something and how novice hear what the experts are saying. That really was never, ever discussed much in my training as a teacher, and no pre-service education back before, before modeling. So we as experts have a tendency to jump past different ideas, and not explain it to the students. And you get "oh, okay. Uh, so I don't understand what you just said because I have no clue how you went from this step to this step, because you're not breaking it down into enough detail for me to follow." Right? That, I think, would be something that would've been helpful, because it allows you to think about how to speak to students.

Kathy Malone (08:01):

'cause our students come to the classroom no matter what level they're at, high school, undergraduate, and they're basically novice, you know? And so how, how do you actually help them make those connections between what you do as an expert and what they do. So how do you talk 'em through it? But I didn't learn that until my PhD program. And Hestenes actually, I think, during one of those workshops, five weeks in Arizona, I think somebody came in and talked to us about it, at one point in time too.

Mark Royce (08:34):

Yeah. He's a brilliant man.

Kathy Malone (08:36):

Yes, he is. He's, he's quite amazing, David is.

Mark Royce (08:39):

Yeah. So if you were talking to somebody who's a teacher, a newer teacher, or someone who has not been introduced to modeling, how would you, what would you say to encourage them to get to a workshop and get started with it? Is there something that you would encourage those who have not been initiated to do?

Kathy Malone (09:02):

Well, you know, I would suggest that they look at just giving your FCI scores, pre- and post- for one thing. If you have not ever done that, when you do that, it can be a little bit humbling, right? Because you think, I'm doing a pretty good job. Kids enjoy the class, kids do well on the, whatever they do, SATs or whatever they do at the school or something. And then you get the FCI scores back and it's like, whoa. That's pretty disappointing. So that makes you kind of reflective, right? If that's happening then maybe you wanna take some steps towards that. Even if it's maybe even just trying out some modeling units in your own classroom.

Kathy Malone (09:51):

I mean, a couple people that... 'cause I did a lot of workshops back in the day, for high school teachers. And I remember a couple of 'em had come to the workshop because of just that actually, they had lower FCI scores. They tried some of the units that were available online at the time, and they did not see changes in their FCI scores. So it was like, let me come to a workshop to see what am I missing? 'cause it goes back to the devil's in the details, so you can read about it, but the devil's in the details and how you actually talk to the students and what you're doing in the class, and what you're having the students talk to each other about, right? And those questions you ask and how you ask 'em, or they seem easy.

Kathy Malone (10:36):

'cause I remember the workshops they used to always say, the first two questions you always wanna ask is, how do you know that? And why do you think that? You know, never answer a question. They ask you something. Well, just like, well, what do you think? You know, why do you think it <laugh>? So never try to answer their questions right away. And those are very powerful questions that make students really think about things, right? And hopefully make them reflect upon their own understanding. But yeah, it's hard, 'cause it's a big commitment, especially if you have to leave your family and stuff for a summer to go for one or two weeks, you know? And I sometimes I wonder about online, 'cause I know they did a lot of online ones. They're still doing a lot of online ones. It's difficult.

Mark Royce (11:18):

It is. But everyone I've talked to says it's so worth it when you do, if you are able to go, you know? That's encouraging. So I read you said that teaching science is like a jazz performance. And I thought that was fascinating statement. Can you explain what you were meaning by that?

Kathy Malone (11:42):

Well, I'm from Nola. I'm not a jazz musician. New Orleans.

Mark Royce (11:46):

New Orleans?

Kathy Malone (11:48):

Nola. So jazz is a big part of my growing up. Yeah. So in a jazz performance, one person, plays some chords, right? And from that, someone else picks up, right? Mm-hmm. <affirmative>, and then they move across, right? So, teaching, especially modeling, is very much a jazz performance to me, because what it is, is that it's not me. It's the whole class, right? So we're performing together, trying to reach a goal. And while I might say something and ask a question of one student that the idea is the perfect, that the classes, that was like, when you leave and you say, whoa, that was a good class. That's when I've maybe only asked a couple questions. And the other students are picking up from what other people have said. Right? So that's the reason why I think of it as a jazz performance. Because if you can get that to click, like some good jazz performances do, that's when everything starts jelling. And the students are actually talking about what they did. And at that point, the conductor is no longer needed. So then you can step out of the room, you know? And that was the goal.

Mark Royce (13:01):

That's a fascinating take. When I read it, I thought, huh, you didn't say this, but I was thinking, as a teacher, you have to learn to improvise also. Which is a strong part of jazz performance is improvisation. And, I am I'm sure you've thought about that a little bit.

Kathy Malone (13:25):

Oh, yeah. I mean, I remember principals telling me that, oh, it must be tiring teaching, you know, so many the same class, you know, the same class. 'cause you're teaching all these physics one classes, you know, you must be boring. You know? And it's like, uh, definitely not. Each class is different. And how far each class gets to is different, because you never know, where you're going, you know? And where you'll

end up and how you'll get there. And it's all in the journey. Actually, the journey's the most important thing, right? So how, how do you actually arrive at your final designation?

Mark Royce (14:04):

Yeah. That's awesome. That's a great analogy. I had never heard anyone put it that way before, but I thought that was really interesting. You're a jazzer.

Kathy Malone (14:16):

<laugh>. Yeah. <laugh>.

Mark Royce (14:18):

That's so cool. So, your main focus in the classroom over the years has been in the physics teaching primarily. But you also have helped develop modeling materials for the biology classroom, which is one of the newer disciplines that have been brought into modeling. Tell us more about your effort there and how you see it has grown from its infancy to today.

Kathy Malone (14:49):

Well, Anita Schuchardt, who is actually a biology education professor now at University of Minnesota, Twin Cities was the first one to mention it to me when we were both teaching at a private school in Pittsburgh, that was switching from a traditional sequence to a freshman physics class. So freshman physics first, then chemistry, then biology. And we had a theme. We decided that energy models would be the theme that connected all three classes together. So students would learn energy models in the initial physics class, and they would use those same models in chemistry and then in biology. So all the teachers had to be trained for it. And so when she went off, and all the biology teachers actually who were junior level biology teachers, had to start teaching.

Kathy Malone (15:42):

They had to teach freshman physics actually for two years, because of, they didn't have anything to teach. Right. So they had to teach that. So they went off to Arizona and for one summer for, I think the workshop was maybe three weeks at the time? And learned physics modeling. And when Anita came back and also another biology teacher there named Bill Dill, oh, and another one named Dudley Parr, they said, we really need to look at the biology, and it has to be modeling-oriented, because if you're gonna do modeling physics, modeling chemistry and modeling physics, then when the kids go into the biology class, and we all of a sudden teach traditionally just, but just with energy model representations, it's like, oh, that's not gonna <laugh>.

Kathy Malone (16:34):

It's like, I don't know how that's gonna work. And it's true. You know, like, what happens when you teach these students to improvise and to be thoughtful thinkers? And all of a sudden you go into a biology class where it's more traditionally taught? That've all said, I'm not sure if we want to teach that <laugh> the class because Oh, yeah. You know, traditionally, because they would come in expecting that science is taught in a certain way, and we wouldn't necessarily be able to do that. So, Anita was the emphasis behind that actually. And all two of 'em were, the other two were also. And they would constantly bounce ideas off of me. And so, um, talking about how we would actually write these units. And so over the two years they taught physics, they started writing, um, these really rough units for biology for a year long biology class.

Kathy Malone (17:22):

They would try the units out in their advanced biology classes that were second-year biology classes at the time, and make revisions. And we'd talk about how to 'cause I actually do have an undergraduate degree. I don't know if I mentioned that, in biology. So that helped out a lot. Oh, yeah. No, I didn't hear way, way back there to find stuff, but sometimes information. Yeah. But, um, so that helped because it's like, well, how do we actually model like photosynthesis? What, what do we, how do, how do we do this? You know, how do we change this lab that we've been using for years into more of a modeling oriented lab and that sort of thing? So that was the beginnings of it. After that, we actually started doing some biology modeling workshops, in Pittsburgh, for teachers, for several years.

Kathy Malone (18:09):

And Anita decided she wanted to get a PhD. At the time, I already had a PhD. And, because of several different reasons, I ended up by getting a postdoc at the University of Pittsburgh, and then an academic position at Ohio State University. And a math-science partnership grant came across my desk application. And I thought, wow, this would be a pretty good idea. Because one of the things we did with the materials in Pittsburgh were, it'd be really nice if there were more math in biology, because we're using all these graphs in chemistry and physics. And usually in biology, kids have a tendency to think biology has no math, which is totally incorrect. And so, how do you actually draw out that, those mathematical principles into the class?

Kathy Malone (19:05):

Right. So we added a lot of things to try to draw the math out. And I thought, well, this grant might be interesting to use to actually maybe do some more, bring some more people in, look at what was originally done, and then make lots of changes based upon different ideas for different people. So that's what we wrote, wrote it, and actually got funded, for three years. Three years. So it was about a million and a half, I think, over three years. And then at the end, we turned those documents over to the AMTA.

Mark Royce (19:43):

So that's all available there at the AMTA site resources.

Kathy Malone (19:47):

They should be, but I do know, they hired a group of people, other biology modeling people, to go through the materials and then they made changes to 'em, that sort of thing. So the stuff that's listed as biology modeling on AMTA, that is materials that were probably like second or third generation from the Ohio State University. So that's what happened. So it was, it was really fun. We had a nice group of teachers from Ohio who had been trying to use the biology modeling stuff from Shadyside in their classrooms and had already been trained for physics modeling and that sort of thing. And Anita was there and a professor by the name of Zaki Sabri, at Ohio State University, was really interested in what we were doing. So he came on board and so we did that, and some mathematician came on board, and we worked through lots of different ideas.

Mark Royce (20:54):

Yeah. That's awesome. So, you know, about a year ago or so, I interviewed Dr. Schuchardt. So any listeners who wanna hear her talk about biology and math and all that integration, they can go to the science modeling talks website and look up episode 31 and hear her talking about this, too. So That's really cool. That's really awesome. So, I wanna talk a little bit about a couple more things with you. One

is, you spent quite a bit of time in Kazakhstan, and that's really interesting to me. The modelers I've talked to have primarily been US-based, and having an international experience like that is really interesting to me. And I think our listeners will enjoy hearing about that.

Kathy Malone (21:54):

Yeah. Well, I moved to Kazakhstan in 2017, because they made me an offer that I couldn't turn down, actually. Over certain periods of time. And so, I went, I taught in the education department, at the time,

Mark Royce (22:15):

At a university?

Kathy Malone (22:17):

University. It's called Nazarbayev University. So it's a English-speaking university in the capital, called Astana. So it's on the high steps. So it's very cold in the wintertime, lots of wind, that kind of thing. So it was a great opportunity. It was a very interesting opportunity. I taught education classes. It's interesting that you asked me that because this brings me back to the idea of what is modeling? We have a tendency to think of modeling just being science oriented. And I remember having a discussion with Hestenes years and years ago. We were talking about how I can see as the years progressed I was no longer a teacher of science. I had become more of a teacher of thinking, like, in other words, because models are all around us, they're not just science. We have to have a model of how to use our cell phone if we're gonna actually do anything. We have to collect data and figure out how to... it just goes on and on. It's not just science ideas.

Mark Royce (23:27):

Interesting.

Kathy Malone (23:29):

So at Ohio State University, I taught a lot of STEM majors who were going into education. More science methods kind of classes, assessment classes, and that sort of thing. And in all cases, I always brought in those same ideas of the jazz improvisation and the whole idea about how you think, right? And how you talk to students and how you move forth in the classroom, whether it was the elementary students or with high school students, that they might be teaching in the future. And so, when I went to Kazakhstan, one of the reasons why I went was because they had a lot of funds for research available. And they were interested in putting some things in place that would last over an extended period of time.

Kathy Malone (24:28):

Here in the United States, you mentioned that modeling ran out of funding. And they had several different grants. 'Cause you have to change the grant every time you apply to National Science Foundation, or DOE. Because it can't be the same thing, you know? Even if it works, we can't put more money into it because we know it works, which we think makes no sense whatsoever. But anyway, so in Kazakhstan, they were interested in trying to build an educational program that allowed teachers who had been taught in a Russian Soviet mentality to become thinkers and therefore get their students to become thinkers, because Kazakhstan's a republic, it would like to become more open. But you have to have people who know how to talk and how to think and act, not just listen to what's happening and not just do what you tell me to do.

Kathy Malone (25:22):

They also needed more people who were Kazakhs in the STEM fields, because Kazakhstan is very rich in all kinds of minerals. And they didn't have enough people going into the STEM fields, and they were constantly bringing people in from outside the country to do that. So they said, come and help us build this graduate department in this university, which has a PhD program, and also master's degree programs in educational leadership, and also do research in STEM. So what I ended up doing was they asked me like, when would be the best time to actually get students interested in STEM? You know, middle secondary, lower secondary or upper secondary?

Kathy Malone (26:18):

And my comment was, the best place to start would be elementary, actually. You know? Because you really gotta get 'em hooked then. So that as they move through, they can continue. So that's where we started. We started with STEM research in the elementary school. So it was modeling-based science units, where the kids collected data and tried to come up with a model, obviously not all the representations that high school does. But it also had an engineering theme in it. So the units were focused on engineering practices. So the students were given a problem that had to be engineering oriented. And then as they were going through and trying to do that project, they realized they needed some science knowledge, and so therefore they had to become scientists to get that understanding and information that they needed for, like, friction or whatever to build this wind turbine they might be finishing with. We have just finished that. We haven't published, well, we have some conference papers on that, but we still have a lot of data we have to go through. And then at the NU area, we also started working on the undergraduate engineering program and making it more project-based, more inquiry oriented, more modeling. That was where we were going. And then Covid came and kind of scattered everybody to the winds. And, you know, so even in high school, I wasn't just a teacher of science. I was a teacher of having kids learn how to think. And so all the modeling practices that I had been using all along, I ended up putting 'em into place in classrooms at Ohio State, and also then in Kazakhstan about how do you actually teach curriculum development and how do you teach assessment to teachers who have never done that before?

Kathy Malone (28:18):

And what kind of model do you build on? How you go about putting that into place and doing that and the steps along the journey kind of thing.

Mark Royce (28:27):

Yeah.

Kathy Malone (28:27):

Yeah.

Mark Royce (28:28):

How did the folks you were working with in Kazakhstan, how did they respond to modeling as you brought that to them?

Kathy Malone (28:38):

They were very open to it. I have never seen a country where the people are so patriotic actually. I mean, because everything they do, they're constantly thinking about how are, how, how, how is this going to improve Kazakhstan? How is this going to improve our students' education so that we can improve Kazakhstan, become self-sufficient, become more democratic, become. So it was interesting. 'cause they were very focused. They were very determined. They were great students to work with. Here in the United States, I think we have a tendency sometimes to take for granted what we have available to us. We take for granted our ability to go to university, our democracy.

Kathy Malone (29:36):

You know, we just take for granted so many things that it will always be there. And in Kazakhstan, it has not always been there, right? Only the highest of the high in high school would be able to go to college back in the day. And the fledgling country used to be very autocratic. And it still was, it was a republic and it had this one president for 30 years, but they constantly were trying to make it more and more open, you know, and wanting to hear the people's voices. And so it was an interesting experiment. It was an interesting experiment and also an interesting experience. It was interesting to see kids, for example, like these elementary kids.

Kathy Malone (30:31):

You go into the classroom and they were trained to be in little rows. There wasn't a lot of talking back and forth. And so we had to train the elementary teachers even how to read in an engaging manner, a storybook we wrote, which is called, Kasakh Course Engineers. And how do you read that to engage the students? 'cause before they would just read, there'd be no conversation back and forth, nothing like kids, what do you think's gonna happen next based upon these ideas? What would you do next? And so it was very interesting. And also to see how the kids really became really engaged in that ability to talk to each other and to develop their own understanding of things. This was at the third grade level.

Kathy Malone (31:24):

So the kids we talked to for pre-interviews were totally different than the kids we talked to in the after interviews, the post interviews.Before you'd ask 'em a question and it'd be like, you, answer me. You, what's your answer? What's your answer? And afterwards, you would ask 'em a question, and it was like, several of 'em would just start talking to you. You know, it's like, well, one at a time. Let's go through this one at a time.

Mark Royce (31:52):

But how long were you in Kazakhstan? When did you, when did you come back to the US?

Kathy Malone (31:58):

June of 2022.

Mark Royce (32:01):

Okay. So you've only been back here for a year or so, so you were there for five years, is that right?

Kathy Malone (32:07):

Yes. I spent some large chunks of time here in the United States, for Covid, because I'd get here and then plane travel would delay. So it would be extended so I'd be teaching online here in the United States in Kazakhstan, till I could get a flight back and that kind of stuff.

Mark Royce (32:22):

Okay. Now you've done a lot of research in education. And were you doing it while you were in Kazakhstan as well? Or was that primarily before you went there? Or tell me a little bit about your research journey.

Kathy Malone (32:38):

The research journey was interesting 'cause I was a high school teacher. I had a PhD already. And someone told me, suggested that I apply to the Einstein program, Einstein fellowship program with the National Science Foundation. Well, with the New York Department of Education. And I ended up applying and I was accepted, and I got a posting at the National Science Foundation.

Mark Royce (33:05):

This was when?

Kathy Malone (33:06):

This was in 2012.

Mark Royce (33:10):

Okay.

Kathy Malone (33:10):

2012 to 2013. Well, it was a year and a half, I was there. And I was posted to a program in NSF called DRK-12, which was research for K through 12. So what I did was I helped set up panels to discuss people's grant proposals that came in, to see which ones we would fund, and that kind of stuff. Participated in those discussions with the other project managers on the team to decide who got funded, who didn't get funded, that sort of thing. And after about a year that I realized that I wasn't sure if I wanted to go back to high school because I saw all these opportunities people had to do research. And I'm thinking, I think that might be where I want to go, because there was such a lack of research in modeling instruction,

Kathy Malone (34:12):

And teachers had always asked me that, it's like, well the only research we had was the stuff that Hestenes and Malcolm Wells had done at that point in time, back in the day, to support what you're doing in your classroom. Because I know when I was teaching in the private school in Pittsburgh, they were constantly asking, well, how do you know this is successful? That sort of thing. So we collected our own data during that transition, to show them that yes, this data is showing that it's working. Right. And Anita and I actually just finally published an article based upon that data just recently, like a few months ago it got published. And it's open access so that you can actually, any teacher or anybody can download it and read it.

Mark Royce (35:01):

Where do they go to? Where would one go to get that?

Kathy Malone (35:03):

Well, the easiest thing would be to probably go to my research gate profile, and you would see it. It's listed there. It's a longitudinal study. 'cause we had data from physics, biochemistry, and biology. So it was over the course of three years. Or they could email me and I could send it to them. So what I wanted to do was I thought, well, let me go to the university level and see if I can actually do some research that would be more up to date for teachers to see that that modeling does indeed work. What are the advantages of modeling? I mean, my PhD was also in modeling, and I published an article from it, years ago in the Physics Education Research Journal, PER. And so it was like, well, there really needs to be more out there for teachers to be able to get ahold to, to show, to administrators, to prove that yes, it looks like it does work, at least in other contexts. So maybe we could give it a try here.

Mark Royce (36:06):

Yeah.

Kathy Malone (36:08):

So that's the reason why I ended up going into a job that allowed me to do research.

Mark Royce (36:14):

Yeah. That's cool. So in all the research you've done, can you tell us what you think is the most important thing that you've learned or you uncovered or discovered in your research? What's the big thing that you want to share with people?

Kathy Malone (36:33):

Well, you know, modeling instruction... We've done research in physics and also in biology. I haven't really done too much in chemistry except for that one longitudinal study. But no matter what context it's in or discipline you're in, the effects on students are huge. And that's the takeaway. Whether they're just learning how to speak English. 'cause we did one study in a class that was for ELAs. No matter if it's in that class or any class, they outperform traditionally taught students, even English-speaking students. So if you are learning how to speak English, English is a second language. And you're introduced to modeling, you do, our research is showing, on par with your English-speaking compatriots using traditional methods.

Mark Royce (37:45):

That's fascinating. I had not heard that piece of information before about modeling. That's really fascinating.

Kathy Malone (37:52):

And like I said, it's not just science, it's in all disciplines. Every discipline can use modeling pedagogy to have similar changes happen to their students.So they become thinkers and can actually use data and information and make sense of the world.

Mark Royce (38:12):

Wow. That's cool. Very cool.

Kathy Malone (38:15):

Yeah, I think so. It's interesting that the idea, these representations that students use and how they link 'em back together can make sense for students, even ones who are just out learning English, because you have so many different representations you can use, one of 'em clicks with you. Then you can actually start seeing the connections across all of them.

Mark Royce (38:38):

So I know you've done research in the area of cognitive and metacognitive benefits of modeling. I assume part of that is what you were just talking about a little bit?

Kathy Malone (38:49):

Yes. Yeah. 'cause that's what you're actually changing. You're actually changing how they think about things. My PhD research actually, we weren't sure if we would see any changes. What we did was we actually had students do what were called verbal talk aloud protocols. So they had to actually talk about what they were doing as they were solving problems. And we did it with modeling students, with AP physics students, and with non-modeling, first-year students. So we had modeling first-year students, non-modeling first-year students. And then AP students. So these were second-year students. Both modeling and a non-modeling group. And it was quite interesting how the approach was totally different. I was just blown out of the water personally. 'cause I was not sure if any of this was gonna work.

Kathy Malone (39:42):

And neither was, 'cause my mentors at the time were Bruce Shabai and Bruce Sherwood, who were big into physics education resource then. We were not sure that we would actually see any difference in how people attack problems. But if you follow the idea that you're teaching your students to think and start off with your problem solving with a model in the classroom, what model would best solve this problem, do you think? And you say, oh, I'm gonna start with this model, and then I can have all these different representations that I can use to solve this problem, right? And if the problem doesn't make sense, then I can go back and use one of the other representations and see if I still get the same answer. In which case I can say, well, it doesn't make too much sense to me, but at least my model representations are falling in line.

Kathy Malone (40:32):

So it makes me a little more confident. So if you model that in the classroom, I was really blown away that they actually do it. You know, these students actually did it. And these kids were actually randomly picked they had to volunteer for the program, but they were not only my students, they were another modeler's students. The non-modelers came from two different classrooms. So we had two modeling student classrooms, different modeling teachers. Different schools, one public, one private. The non-modelers, we had one private, one public. So the modelers, no matter who taught 'em, they went in and they said, oh, okay, this seems to be a constant acceleration problem to me. So I'm gonna start off by doing this.

Kathy Malone (41:23):

And I purposely built some of the questions in so that they would get these strange answers. This tall building would be like so tall, and modeling kids would actually say, darn, that's a really tall building that's like 10 football lengths high. Do they even have buildings that tall? And they said, but you know, I

think I'll check that. So they would go back and they would do another way. They would solve it a different way. They say, well, the answer comes out the same. That still seems to be a really tall building, but I guess I must be right. Maybe? Whereas the non-modelers, they would just start plugging and chugging, you know, it'd be like, oh, what equation can I use?

Kathy Malone (42:06):

They fell into the classic, I only have this one representation and that's algebra. And when they got to this really strange problem, at best, maybe 20% of 'em said something along the lines of, I'm not sure that makes sense. Most of 'em said, okay, I'm done. I got my answer. I'm done. And 20% that said it didn't make sense, they would think about it, they'd scratch their heads. They maybe would go back and try to replug the problem, the numbers back into the equation, and recalculate it out. But that's about all they did. And they said, oh, okay. Well, I don't know.

Mark Royce (42:47):

Wow.

Kathy Malone (42:49):

I did the math right, so it must be okay. So that was the most amazing thing I thought about, 'cause we always ask students at the end in modeling, does that make sense to you? And you can say that in the classroom till you're blue in the face, but do they actually carry that forth in their own problem solving? It seems like they do. So again, I guess it's just the devil's in the details, you know? That's such a powerful thing for students. Even if they don't realize it while they're complaining about the class. It's like, why are you making me do this?

Mark Royce (43:29):

Well, Kathy, we're kind of running out of time and I could talk to you another hour or so about stuff that you've been involved with. Maybe we'll do another session sometime. That would be really cool. But, but gosh, I just want to thank you so much.

Kathy Malone (43:45):

Thank you very much for the opportunity. It's been a lot of fun. The time went by very, very quickly.

Mark Royce (43:52):

It does, it goes by, especially when you're talking about something that you're passionate about, you know? And you obviously are. And it's been a joy. I will post your research gate link on our website and your email, if that's okay.

Kathy Malone (44:09):

That's fine.

Mark Royce (44:10):

And then I'm gonna also post about Dr. Anita Schuchardt's interview, so people will wanna check up on that. But gosh, this has been really great.

Kathy Malone (44:23):

Yeah, it's been fun.

Mark Royce (44:23):
I wish you the very best living in paradise.

Kathy Malone (44:28):
Yes. <laugh>.

Mark Royce (44:30):
So I am jealous. Hawaii is such a beautiful place, and you're on Hilo, right?

Kathy Malone (44:37):
Yes. I'm in Pahoa, actually, which is a little bit south of Hilo.

Mark Royce (44:41):
Okay. Wow.

Kathy Malone (44:42):
It's a little small town. About 30 minutes away. 40 minutes away.

Mark Royce (44:47):
Awesome. Okay, well, I'm gonna say goodbye and say thank you very much.

Kathy Malone (44:52):
Well, thank you very much too.