

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

Hi, Earl, how are you doing?

Earl Legleiter ([00:02](#)):

Hi, Mark. It's nice to be with you today.

Mark Royce ([00:04](#)):

I'm looking forward to our conversation. I've gotten a little bit of information about you, but why don't you tell us a little bit about your educational background?

Earl Legleiter ([00:16](#)):

My college background is that I went to the University of Kansas where I picked up a degree in biology. And after I completed that degree, I decided I wanted to be a teacher. So I went to Fort Hays State University to get my teaching licensure. I then taught in mostly rural schools throughout my career. And what I found in working in rural schools is that I had to teach chemistry and physics and biology and earth science. And so I had lots of things I had to teach, and of course I was not well prepared to teach in physics. I graduated from the university with like seven credit hours in physics. So I had to brush up on physics, which got me started in modeling instruction.

Mark Royce ([01:10](#)):

So how were you introduced at first to the modeling methodologies and instruction?

Earl Legleiter ([01:17](#)):

Well, I got a letter from Jane Jackson, I think, that mentioned the modeling program at Arizona State University back in 1995. And I was pretty much unaware of modeling instruction at that time. And I knew I wanted to try to do something to improve my teaching of physics, you know, because I had been very traditional in my methods. I was a lecturer, but I knew there was better ways to teach. And so when I got the letter I decided to apply and I was surprised when they accepted me because I was kind of a crossover teacher. I didn't have much background in physics. So I was a little bit worried about going to the workshop in 1995, because I knew there would be other teachers who were much better prepared in physics than I was.

Mark Royce ([02:21](#)):

So, as a result of attending the workshop, did it change your opinion about teaching physics or how did it impact you?

Earl Legleiter ([02:30](#)):

Oh, absolutely. It completely changed the way it taught physics and it also changed the way I taught everything. I was part of the leadership group in 1995 where we spent five weeks at Arizona State that summer, and then the following summer, we spent additional five weeks, and then we had a third summer where it was like a two week, I think it was two weeks.

Mark Royce ([02:58](#)):

Wow. Yeah.

Earl Legleiter ([02:59](#)):

So I had, I guess some really good training in modeling instruction. And of course after I received the training, I was using it in my high school physics class, at a high school I was teaching at, at the time.

Mark Royce ([03:15](#)):

I know that you like to help create student engagement and in your classrooms and helping develop the ability to manage discourse in the classroom. I know that's a focus of yours. Tell our listeners about how you're doing that, how you're creating that student engagement and how you're managing discourse in the classroom.

Earl Legleiter ([03:38](#)):

That actually has evolved over the years. And I think that early on, I was reasonably good at involving all of the students, engaging them in, sharing their ideas and so on. Mostly this came about through techniques I learned at the workshop, you know, the circle whiteboarding, having randomly selected presenters. And, so students knew that there would come a time when they were going to be presenting a whiteboard solution or whatever, or a lab result at some point. And so they became quite comfortable with getting in front of the classroom and discussing the physics that we were trying to learn. And, I think I was very supportive in helping them feel comfortable in front of the classroom, starting out with them, going up as a group and eventually going up as an individual where they had their partners at the table to help them out if they needed it and organizing the classroom in such a way that everybody felt like they could contribute to the discussion and not fear being ridiculed for it.

Earl Legleiter ([05:07](#)):

You know, the only rule I had in my classroom is that everybody had to be nice. You know, they had to be nice to each other. And of course they had to be nice to me. I always liked that too, you know?

Earl Legleiter ([05:19](#)):

But over the years, that kind of evolved in terms of how I -- selecting groups now and what I'm doing is I'm changing up groups frequently. And so when students come into the classroom, they are randomly assigned groups in a way that they understand that. So basically I have a set of cards-- playing cards. They come in and they pick a card and they realize that's their group for the day. Okay. And then, I am asking them to work on problems on vertical whiteboards rather than sitting at their tables. And so, basically this gives them a chance to stand up and I think they have better engagement when they're standing rather than sitting. And so we have like, you know, half a dozen groups around the room that are working on vertical whiteboards solving problems, discussing in their groups, and so on. And then they share that out with the-- you know, their solutions or their proposed solutions-- with the rest of the group.

Mark Royce ([06:27](#)):

Yeah. That's great. Where are you teaching now?

Earl Legleiter ([06:31](#)):

Well, actually, I currently work at Fort Hays State University. I'm not a physics teacher at the current time. It's been a while since actually I've been in the classroom, but I continue to offer a large number of modeling instruction workshops. And that was one of the things that was, I guess, a spinoff of the

workshop in Arizona, so many years ago. We were trained as modeling workshop leaders and I wasn't really sure what that meant at the time.

Mark Royce ([07:09](#)):

Now, are you talking about back at 1995?

Earl Legleiter ([07:14](#)):

Yes. That workshop at Arizona State University was a leadership development workshop. And so I think the expectation is that we would be trained to go out and share what we have learned with others. Okay. So during the summer of 1997, when the group met again for a two week session at ASU, I wasn't able to attend. And actually what I chose to do during that summer is to spend two weeks hiking in Philmont scout camp with my son on a boy scout backpacking trip. And I felt a little guilty about that. So when I went back to my home in El Dorado, Kansas, I had contacted a physics professor at Wichita State University to tell him about the modeling workshop and how it was a great new way to teach that I wanted to share with other teachers. And he and I put together a grant proposal, which at the time was an Eisenhower grant proposal that provided funding for my first modeling workshop, which I did at Wichita state in 1998. And I think I was probably the first person from that group of teachers that got the funding to actually lead a modeling workshop like I had at Arizona State. Of course that was only a three-week workshop as opposed to the five weeks, for two summers we did at Arizona State.

Mark Royce ([09:04](#)):

Yeah. I think it's very rare that there's a five-week workshop anymore these days.

Earl Legleiter ([09:09](#)):

Yeah. I think, I think it is.

Mark Royce ([09:10](#)):

It's either two or three. Yeah. So you've been leading workshops since '97. That's just awesome. Um, okay. I have to a couple questions floating around in my head. First, let me ask you, what are you doing at the university these days? What's your focus?

Earl Legleiter ([09:30](#)):

Right now, my major responsibility is to train pre-service teachers. So I am teaching a seminar class whereby students are learning about teaching STEM, next generation science standards approaches to teaching STEM, science and math. And also the focus is on rural communities. And so these teachers, these young people, eventually work in a rural setting, mostly in Kansas, but other states as well. They are awarded a Noyce scholarship. This scholarship is like \$14,000 per year. And for each year that they accept the scholarship, they teach in a rural school district for a couple of years. So it's a great, and of course I'm using modeling techniques as, as part of my seminar class. We do like a three week unit on modeling instruction, which is basically an introduction to it so that they have some idea of what it is all about. And of course, then they can use some of that. The other part of my work at Fort Hays state is I'm also involved in research. We have a research project that takes up about half of my time.

Mark Royce ([10:50](#)):

Cool. So those students, when you introduce them to modeling techniques, you know, do you find that a lot of them will go on and attend a full on workshop with AMTA?

Earl Legleiter ([11:02](#)):

But certainly it's something that we try to encourage. I offer workshops at Fort Hays State during the summer as well. Usually, I'm thinking this has been a while now because of COVID, but we did a chemistry workshop, I think in 2019. I'm doing a workshop, in a school district in Southeast Kansas this summer, which is an introduction to modeling instruction. So during the summertime, most every summer, I am doing one or more workshops and I've had a lot of support for that in Kansas. I started out in Wichita, Kansas. Wichita State University, and then a neighboring university found out about it and had actually gotten --this is Emporia State University that got me started with doing some modeling workshops. And this is like in the early two thousands.

Earl Legleiter ([12:05](#)):

And then of course, Fort Hays State University had gotten funding for a summer workshop that we did. We did as a partnership between Fort Hays State University and Emporia State University, whereby we had a chemistry modeling workshop in Emporia State, a physics modeling workshop at Fort Hays State. And so teachers could choose where they wanted to attend and that project went on for three years. Then there was an MSP funded project at the Wichita school district; that was a three year project. We also did a project in Topeka. So around the state, there had been quite a number of opportunities for teachers to get trained in modeling instruction and it really has made a difference, I think, in the state. But at the same time I've done workshops in various other states, including California, New Mexico, Colorado, Michigan, Missouri, Utah. And all of that developed from that initial leadership workshop back in 1995. So probably to date I've probably done about 20, 25 workshops.

Mark Royce ([13:30](#)):

Yeah.

Earl Legleiter ([13:31](#)):

In modeling instruction.

Mark Royce ([13:33](#)):

So after doing that many, I mean, obviously you're a very proficient and, I would call it, expert in modeling instruction. What are the things that you've learned from doing all those workshops? What are some key points and recognitions that you've developed from doing that many workshops?

Earl Legleiter ([13:57](#)):

Well, I think, for teachers, it's a journey. It is a process where by you can get started with modeling and you can implement it in your classroom, but it takes repeated practice to become good at it. And teachers, I think are reflective in terms of how it's going and they are continually improving their skills. Now, the workshop I'm doing this summer in Goddard was brought to my attention by a former participant in the Wichita workshop in 1998. And he has some teachers that are not doing well in their instruction to their physical science course. And so he's asked me to come to do a workshop there. And so, he's been doing the modeling instruction for 20-some years now. And it takes practice. It's not an easy thing to do, but you keep working at it and you keep getting better at it. And that's what I think.

Teachers need to understand. You're not gonna be perfect the first time you try it. You gotta stick with it. You gotta continually refine your work and so on.

Mark Royce ([15:34](#)):

Are there other tips or advice that you would give to teachers starting out in modeling or even people who've been doing it for a while? What would be your top tips or recommendations for people?

Earl Legleiter ([15:48](#)):

I think you need to let your community know that you're doing things differently. And what your expectations are. You are expecting to build a classroom where students are being asked to think rather than being the passive recipient of information. And some people get in trouble for that. You know, because they'll hear complaints from parents that say, well, the teacher's not answering my student's questions, you know, and that does happen. And so, I think you need to be patient with the process, let parents know what you're doing, let other teachers know what you're doing and let administrators know what you're doing and give them an opportunity to see it in action. You know, once the administrators see it in action, they come to understand that what you're doing is you're developing and using models, which is one of those science and engineering practices from NGSS. And they come to realize, this is what science instruction is supposed to be like.

Mark Royce ([17:03](#)):

Right.

Earl Legleiter ([17:04](#)):

But they don't realize that at first.

Mark Royce ([17:08](#)):

That's really good advice. I read in a document you sent me that you seek to build a thinking classroom, Tell us what you mean by that term.

Earl Legleiter ([17:22](#)):

Well, the expectation is that students are expected to think in order to learn physics. And of course, when they're developing a model, they have to be able to, build that model with the various representations of the model and then be able to use it in practical problems. And so we begin the lesson with a thinking task. Okay. So when students come into the classroom, they may be asked to complete a problem that engages their thinking. And I talked about how we frequently form new groups. And, so when they come to the classroom, they are assigned a new group and they are going to be solving a problem using the vertical whiteboards in their group. And so there's a lot of discussion that goes on with helping students realize that in order to learn physics, and I think it's true in order to learn anything, it's gonna take significant effort on your part. You know, I can help you with that, but I can't do it for you. So you have to come into the classroom expecting to think and use your reasoning ability to make sense of the content. Actually that comes from -- those ideas come from a new book I came across, that is called building thinking classrooms by Peter Liljedahl, a hard name to say. But that book, I actually used in my course at the university with the math people to help them understand that students probably don't learn math very well by copying what the teacher is doing and trying to do problems by repetition, by trying to simulate, trying to follow the instructions the teacher gives. You know, what we really need them to do is to think about the math, make sense of the math that way.

Mark Royce ([19:54](#)):

My wife has talked often about the fact that one of the things that she struggles with in the classroom is students coming in to her high school classroom. She teaches chemistry in the sophomore year, but one of the things she talks about is how unprepared her students often are in their math understanding, that she's often having to bring them up to speed in math. What's your experience with dealing with that issue?

Earl Legleiter ([20:26](#)):

Right. Students are not well prepared in math. And I think it's largely because the way math is traditionally taught. One thing happens though, in a modeling classroom, students tend to improve their math skills. And the reason that is because they are using multiple representations of a concept and, you know, it's like, they have a diagrammatic representation of a motion map, and they have graphical representations of that motion. And now when they're applying math, you know, they're doing an acceleration problem, then they can see what that mathematical model represents from their diagrams and their graphs. And then it makes a little more sense to them to be able to make those connections. But yeah, but I taught physics to ninth graders, a physics first approach when I was, in high school teaching. And what we did is the people who enrolled in the freshman physics course had completed algebra on the eighth grade level.

Mark Royce ([21:45](#)):

Right.

Earl Legleiter ([21:46](#)):

And, so they did have some math background, but during the course of the physics course, then they were able to improve their math skills, I think significantly because they begin to see why math is important, where it can be applied, and where they can make sense of it. And actually, this just as an aside, I had students in the physics first, their freshman year, and I gave them the FCI as a pre- and post-test. And I kept their post-test scores from the FCI when they were freshmen. And then when they started physics in their senior year, a second physics course, I gave them the FCI again. And I was surprised because the average score between their freshman year and their senior year was the same.

Mark Royce ([22:49](#)):

Huh.

Earl Legleiter ([22:50](#)):

They didn't lose it over over years. They retained that knowledge. Which is impressive, I think.

Mark Royce ([22:57](#)):

It is. So, you mentioned that at the university, you also do a lot of research, in your department. And I think I read that some of it was about professional development needs for science teachers and you did some surveys and you've done some research around that. What, what have you discovered about the professional development needs of science teachers through your research?

Earl Legleiter ([23:32](#)):

Well, this research project is not a modeling workshop research, per se. But what we're doing is, we have provided some professional development, for middle school biology, life science teachers. And we did a face-to-face workshop on campus with a cohort of about 20 teachers. And at about the same time we did an online version of the workshop with a group of 20 other teachers. And what we're doing is we're comparing the two groups. The thing is, in rural states, like Kansas, people frequently have to travel long distances to get to a face-to-face workshop. And so what we're trying to do is develop a model for delivering online professional development. And so now we're in the process of collecting data and comparing the results of those two separate professional development modalities. So we'll see how that works. And I think if we can make it work, we can use -- what we would like to do is to adapt modeling instruction to a online program.

Mark Royce ([24:54](#)):

Now, do you mean like offering online workshops for modeling? Is that what you're talking about?

Earl Legleiter ([25:00](#)):

Correct.

Mark Royce ([25:01](#)):

Yeah. Cool. I know there's been some of that, especially through the pandemic years. There's been some work at that. My wife has been involved in both face-to-face, several of those, as well as some online, she greatly prefers the face-to-face.

Earl Legleiter ([25:21](#)):

Oh yeah. I do too. I do too. But you know, sometimes that option isn't available.

Mark Royce ([25:28](#)):

Right.

Earl Legleiter ([25:29](#)):

You know, with the pandemic and of course with the teachers that might have to travel four, five hours to get to a place which happens in Kansas.

Mark Royce ([25:40](#)):

Yeah.

Mark Royce ([25:40](#)):

You know, the costs involved in that. Yeah. So what do you find to be the greatest advantage of a face-to-face workshop?

Earl Legleiter ([25:49](#)):

There is so much more that goes on in a face-to-face workshop, and that may be things that go on outside of classroom time. And the teachers get to know each other, they get to, you know, it's the social knowledge that they develop and they make connections with each other that they can use then to develop a professional network with people that were in their class. You know, it's kind of like the modeling list serve that started way back. You know, in 1995 and that professional networking is critical,

I think, for people who are trying to implement modeling instruction on their own, you know, in an isolated classroom and they need support of each other. So what we've done is we, in some of our workshops, we've provided, you know, smaller subsets of a list serve or Facebook kind of communication groups.

Earl Legleiter ([26:55](#)):

Which is you know, when I-- this is 20 years ago-- I did a workshop and the teachers decided that they needed to form their professional network. And so they formed a Facebook group, which was called the Kansas modeling physics group. And I was unaware of this. And pretty soon I got an email from one of the participants and said, you know, you really need to join this group. And I did, and it was kind of funny, Mark, because I wasn't on Facebook at the time. And so I joined the group and I had three Facebook friends: my wife, my son, and my daughter. And pretty soon my daughter was getting messages that said, please help Earl Legleiter make friends.

Mark Royce ([27:48](#)):

<laugh>

Earl Legleiter ([27:50](#)):

Because I didn't have any friends in my Facebook group.

Mark Royce ([27:53](#)):

Wow. Yeah. I know there's a lot of resources available on the AMTA website and through their efforts and stuff. Have you been connected with that?

Earl Legleiter ([28:08](#)):

I've been a lifetime member of AMTA. I served as the president of AMTA and this is probably about 10, 15 years ago. When I was president of AMTA, that was the first year we had a AMTA summer conference, which is continuing today. And actually I am currently temporary vice president of AMTA because they needed somebody to step in for just a short term and I've been working with AMTA as vice president for about a half year now. But I think this is going to end probably once the new election, which is probably coming up next month or so.

Mark Royce ([29:02](#)):

Yeah. Wow. So you've invested a lot over the years into AMTA's efforts. That's great. I'll just mention for our listeners, if you're not already aware the AMTA website can be, you can get into it through modeling instruction.org on your browser. So if you wanna learn more about the AMTA, that's the place to do it. There's a lot of information there.

Earl Legleiter ([29:30](#)):

Yeah. And it's important to be a member, because you have access to all of the curriculum materials and of course all of the communication that goes on, on that website.

Mark Royce ([29:45](#)):

Yeah. I know you can find out about their workshops, you know, that are scheduled and how you can get registered for those or attend a virtual workshop online or attend a face-to-face workshop, usually

during the summer months. That's awesome. So modeling, boy, when you were introduced to it, it really impacted your career, it seems like. How would you define your relationship with modeling and the impact it has had?

Earl Legleiter ([30:20](#)):

Well, it completely changed the way I was teaching to begin with, but also it helped me to develop my leadership capacity. You know, over the years I was able to do things I wouldn't have really thought, I would've been able to do, with leading workshops and so on. And, you know, it was something that I bought into because I knew students were learning physics and I knew it was a better way to teach, you know, so then of course I expanded that to include modeling chemistry, modeling biology, or whatever it was that I was teaching. And since I was at a rural school, I was teaching a lot of different sciences, but modeling also gave me an opportunity to be awarded various teaching awards that wouldn't have happened. It just wouldn't have happened, because I was just an ordinary teacher, maybe better than some, but probably not as good as a lot of them. But it made me a great teacher, I think.

Mark Royce ([31:37](#)):

Yeah, that's awesome.

Earl Legleiter ([31:38](#)):

I'm glad to share about modeling. I think more people need to know about it. More people need to step up and engage in modeling instruction because it makes a big difference for students.

Mark Royce ([31:53](#)):

Well, thanks. And again, for you taking the time to do this interview has been great and it's been very informative and I know that our listeners are gonna get a lot out of it. So I just wanna say thank you Earl for taking the time to do this with me.

Earl Legleiter ([32:11](#)):

Thank you, mark. Appreciate it. Glad to do it.