Mark Royce (00:00):

Hi, Ariel. Hi, Brenda. How are you guys doing?

Ariel Serkin (00:04):

Hey, Mark. Nice to see you.

Brenda Royce (00:06):

It is good to see you.

Mark Royce (00:07):

Me too. I'm interested to hear about this topic today for this episode, cuz I think it's gonna be very interesting to our listeners. I know you guys just recently finished a workshop online workshop for the AMTA and it was entitled if I have this right, "Improving student mathematical reasoning with modeling instruction." Is that right? That the right title?

Brenda Royce (00:38):

Yes. Correct.

Mark Royce (00:39):

Is it long enough? Was it long enough for you guys?

Brenda Royce (00:41):

We can make it longer.

Mark Royce (00:43):

<laugh> oh, <laugh> improving student mathematical reasoning with modeling instruction. Now this is a focus on math, but you guys are chemistry teachers, right? And so why are you doing a webinar about math?

Brenda Royce (01:02):

Well, because, all... Shall I make my quote?

Ariel Serkin (01:08):

Please.

Brenda Royce (01:08):

All of science, all of nature is quantitative and students have to be able to reason about the quantitative nature of the world around them in chemistry and in every other science. And that is an area that students struggle in quite frequently. So for them to understand nature, they're going to have to be able to reason with the quantities that nature presents to us.

Mark Royce (01:39):

Brenda, I'm gonna have you lift your mic up. I'm gonna have you lift your mic up. So it's in front of your mouth. Yeah. <laugh> Ariel. I'm not too worried about yours. I think once we just find this spot. Oh, look at that. Yeah, that's good.

Brenda Royce (01:56):

I love your necklace.

Ariel Serkin (01:58):

Yeah, it's a good look.

Mark Royce (01:58):

Okay. Now I'll cut that out and then we'll come back right back to here. Ariel, why are you guys focusing on math in the chemistry classroom? I see the need for it from Brenda, but tell me your perspective.

Ariel Serkin (02:17):

It's really the same thing. And we actually, the webinar that we did most recently for AMTA was modeled off of a workshop we did this summer at the biennial conference on chemical education at Purdue University in Indiana, because it was really important for us to have this conversation with other chemistry teachers. There has been a push in certain chemistry classes to make it completely conceptual and to remove the mathematics from it. And what Brenda and I are saying is, is that you can't remove mathematics from chemistry, that it is inherent to nature. It is inherent to the discipline. It's inherent to the world. And we wanted to help have conversations with other educators and at BCCE it was chemistry educators at this AMTA webinar we did, it was for all size types of science educators, ways that we can bring this and help identify student struggles and address them really early on.

Mark Royce (03:26):

Can you guys describe what the webinar was like for those who weren't able to attend? Can you tell us about some of the content that you covered and kind of the approach you took? I mean, whatever you can tell. So we have a picture of what it was?

Brenda Royce (03:44):

Trim this down. <laugh> Well, one of the things that we had to look at was a bit of the nature of the problem, if you will-- take a very scientific approach here. We have to look at the nature of the problem and what it is that students struggle with. Kind of one of the things is the difference between novice and experts in the area of science and how they think differently about knowing and what that means. So for instance, students, if you ask them, how does this compare to that? They will always subtract the two values just about, I don't know, what do you say 90% of the time?

Ariel Serkin (04:27):

Correct.

Brenda Royce (04:28):

It's just a really common novice way of thinking about things. When they wanna know if they know something, they look to see if they got the right answer, but not the reasons behind it.

Brenda Royce (04:41):

Whereas of course, scientific community is the why. And you know, what caused it to be that way. That's our definition of knowing. So moving these novice scientists into a more mature way of looking at it, but in modeling, which it's been very successful in taking ideas and putting them into multiple representations. So we would describe in words, we might use graphs, we might use diagrams, we might use mathematical expressions, in order to get a coherent picture of an idea and, one of the things I've been realizing in my class and in talking with Ariel, we both realized, students don't understand their mathematical reasoning from a conceptual level. And we've realized as we've been working, that some of the things that have been effective have been when we turn those mathematical ideas into diagrams, into diagrammatic ways of thinking about the reasoning by giving concrete form to the quantitativeness that we're looking at and how it works together. Something to add, Ariel?

Ariel Serkin (06:04):

So we began exactly, as Brenda said, by identifying the problem and what we saw as techniques to begin to address and we're educators. So we know that nothing is perfect for all people, but how do we see our students being able to work through it? And we really try to also get to with our participants in this workshop, why this is so crucial and in many novice chemistry classes or in science classes in general, it boils down to memorizing or manipulating different formulae. It's a purely algorithmic response to understanding science is, oh, I can get a right mathematical answer. That means I understand the science. And while we through this workshop and webinar tried to make sure that people understood that it was the conceptual understanding, that was most important. And once you understood the concepts of these main ideas of numbers and quantities and relationships, all of a sudden you can have transferable skills and it's not about memorizing many different formulae. It's just about understanding what these things are.

Brenda Royce (07:28):

And that language is becoming natural to the two of us. But when we talk, we're talking about that, not students, and sometimes even educators drop their guard and act like everything with a number is just treated like a number. And yet in the science community, we know that when we say two grams, we're talking about amount of matter, you know, a mass. But if we talk about two meters per second, that's a relationship between two different quantities, time and position. And students do not make that distinction time. You know, two meters per second to them is often no different in thought than two meters, but those are very different. One describes the rate of motion of a car. And the other just simply describes how far -- anything, could be a length, a distance traveled, whatever. And, um, I know one of the first doorways into this for me was recognizing students don't get that distinction.

Brenda Royce (08:32):

If it has a number in front of it, that's what it is. And I know science teacher response has often been, you gotta get the units on it. You gotta get the units on it. You gotta get the units on it. And we have the phrase, no naked numbers, but the students often just see the teachers making me add these letters for no particular reason other than they want them there. It's not adding to their thinking because they don't see the distinction. They don't see a meaning difference between them. And so, there's a difference between say in the store, um, I need to buy two pounds of meat, or I have $20 in my wallet, but the really crucial thing is how many dollars per pound is this roast I wanna buy, or if I wanna buy a bag of apples, how much does it cost me per pound? Cuz that's how the grocery tells us what it is. But in that setting, they get that the dollars, the money I spend, is different from the price listed on the item in

the grocery store, but they don't transfer that over to, there are different types of quantitative information that nature provides for us. And we are simplifying it. I dunno, simplifying quite the word, but we're distinguishing quantities that are single measurements and relationships that have two different measurements that are intricately linked to one another.

Ariel Serkin (10:10):

And the other thing that we are also distinguishing between these relationships and these quantities is actually what a number is because our students just think a number is a number is a number and we don't deal with numbers the same way that a student in a math class does. We think of that, that mathematical skills are the same, but we look at numbers differently because in our classes we often deal with quantities and relationships and not as often numbers the same way.

Brenda Royce (10:50):

When I ask my student, what's a number, the whole classroom gets really quiet and there are these inward thoughtful looks on students' faces because they realize they don't really quite know how to say it. And their efforts to try either, come back to trying to give us a quantity

Brenda Royce (11:10):

Or they think of a numeral. And yet a number is an abstract idea. We only know what number to use in a quantity after we've defined something that we can call "one." And so it's actually a comparison, which is why we say six grams because the gram defines how much one is. We have some agreed upon amount of matter that is one gram, but we know it's six because this one is and where the human mind manages to hold that relationship in a knowledgeable way, I haven't quite figured out entirely, but we do it. We understand what six ness is.

Ariel Serkin (11:58):

The word, Brenda, is actually called subitize

Brenda Royce (12:02):

Subitize.

Ariel Serkin (12:03):

Subitize that we can like Intuit some of these numbers easily. I learned that in one of the classes I took with Colleen Megowan, actually an article we read so subitIze that we could like intuit numbers and babies can even do this. So it goes back to nature by itself and humanity. We quantify thing, and we try to get these things out. And then, in one of our conversations, I said, Brenda, numbers are adjectives. And we had this whole conversation that we're talking about adjectives and not nouns. And these are all descriptors.

Brenda Royce (12:43):

Yeah, because as Ariel pointed out in our own language, we say like three blue cars, three is in this position of an adjective just like blue. And we even have a special place for it as the lead adjective. Um, but that led me to the thought and I kind of had that there, but it helped put some language to it. You know, when students start struggling with math is when they stop using manipulatives often. Not guaranteed, but often. So they quit thinking of it in concrete terms with things that they're in front of

them or that they can handle or draw or something. And they start doing completely symbolic math. And that means that there is no defined "one" in any of their thinking. There's not an object or something like it to help give meaning to the numbers they're working with. And that's when they start to struggle with the mathematical symbols and algebra is almost entirely symbolist. I mean, you know, entirely abstract.

Mark Royce (13:55):

So when kids enter algebra, that's kind of when they stop using the manipulative form of

Brenda Royce (14:02):

No, it happens in elementary school, usually. More so the focus is on learning all the math facts maybe, or trying to do, you know, various forms of division or fractions or whatever. And it's not that there's none. I think it's beginning to come back to more of that in the lower grades, but yeah, by algebra, it is turning into a really abstract symbol set. And if you think about trying to understand reasoning, when you're only speaking in adjectives, how easy would be to lose that idea of what it is that you are talking about. Those of us who've already made strong connections with numbers with actual things will automatically put something in there to make it make sense.

Ariel Serkin (14:52):

So our goal here is to take these abstract concepts and to make them a little more concrete and to put back these diagrams and actual manipulatives, in some case, to help build their conceptual understanding. And at the same time they're building their mathematical confidence in what we're doing, because there's, chemistry educators and I'm sure other physical science and math, oh, you teach chemistry. Oh, I hated I can't do math. And what we're doing is we're showing them that they actually can do it by building these concrete ideas.

Brenda Royce (15:34):

Yeah. Cuz as Ariel pointed out the human mind is actually wired to do it when it has meaning.

Mark Royce (15:41):

So you guys are teaching chemistry. How are you integrating these ideas into maintaining your curriculum for the semester for chemistry? You know, gimme some practical ways that you guys are integrating these ideas in your classroom if you can.

Brenda Royce (16:00):

Well, one thing is, we were just working with density this week and I had them diagram what it meant to have 2.7 grams per milliliter, except I simplified it to three. They had a piece of aluminum and we used little tiddly wink counters in order to represent a unit of mass. And we drew on a little small white board.

Mark Royce (16:27):

You mean little physical tiddly, plastic.

Brenda Royce (16:30):

Yeah. Little colored discs.

Brenda Royce (16:32):

Yeah. Yeah. So they're little green and blue and purple and red and all those colors. And they would have a set of these that would say, okay, these are representing units of mass. Now draw an object on your whiteboard that has so many units of volume. So like they would put maybe a square and divide it into fourths and have four, one milliliter portions. And then if they had a density that was three grams for every one milliliter that's another piece is making sure that for every language is in there, they pretty quickly intuit that they need to put three grams into every one milliliter block in front of them. And then they realize, oh, we just calculated, calculated in quotes, how much mass those four milliliters had.

Brenda Royce (17:24):

So they could visualize it and they get it. And then I took them and had them translate that into the calculations that would work using density, which is a relationship between mass and volume as a single ratio to get the calculation to work. And then they see how it works and why it works. And then we would also reverse it and give them a mass and ask them how much volume that was. And they would just naturally just group it up. Oh, well I need to put three gram groups together. And every one of those is one milliliter and they drew the boxes to give them one milliliters. And then we worked out the math. So it's like solve it visually tactally and then put the symbols on it.

Ariel Serkin (18:08):

And what's so funny about is that when you start doing it this way, the students kind of look at you like, yeah, obviously this is how you do it be because it is natural for us to think this way. We have put back the manipulatives we've put back the way people naturally think by giving these ideas. And then in our conversations, when we have developed as a class, some of these vocabulary terms. So if we have developed the term mass, we are at what Brenda and I, this after our conversations this year is we're actually that having them record, it's a quantity. What are these, the units for it? And then as we develop more, we're beginning to label things as quantities and relationships and what are they comparing? So they have this running list all the way throughout. So we're making it very explicit. What are our quantities? What units do we use for our quantities? How can we represent them and what are our relationships and how do we use these relationships to connect quantities? So as we do it, we build it all the way throughout. So explicit with our diagrams, explicit with our vocabulary. And they're beginning to become a little more confident. And I mean, I'm learning this from my conversations with Brenda and we've been talking about this for a while and each time you do it gets better and better, and it's more and more fun.

Mark Royce (19:42):

So you guys are seeing an improvement in student learning by integrating these manipulatives and tiddly winks and

Brenda Royce (19:50):

<laugh> yes.

Ariel Serkin (19:51):

Yeah.

Brenda Royce (19:52):

I had a student come into my room yesterday afternoon to get some help cuz she was like-- I asked her, how do you feel about math in general? Just to kind of gauge cuz you know, still learning the students here at the beginning of the year. And she said, I'm pretty good. And she said, I'm, you know, I feel really good with fractions, but these, what we're working with looks like fractions. But it doesn't make sense to me. In other words, she was looking at it through the wrong lens and I actually went through and used these tiddly winks to show her the difference between a fraction and these relationships of parts within like so much mass that also belongs with so much volume for the same object versus here's eight cookies. Somebody ate two of them. That's one fourth and showed how that works.

Brenda Royce (20:43):

Here's four grams per milliliter. This is what it diagrams out as. And we're comparing two things within that object system thing that we're talking about that substance and by diagramming it and again, then translating it into the mathematical. She realized what the distinctions were that sometimes we're comparing parts within, sometimes we're comparing a part to its whole. Sometimes we're comparing various parts to the whole. We used a car parts example, you know, four tires per car, one steering wheel per car. The system of a car has all these parts in it and she could visualize it as you had all these different colored dots on to represent the parts of the car, the simplified version of a car <laugh> mm-hmm <affirmative> and had her work out some things and how you translate that into the mathematical expression. So I know when we were doing our workshop at BCCE, we had one of our slides was experience verbal diagrammatic and then symbolic.

Brenda Royce (21:58):

Yes. That experience into verbal and diagrammatic tools helps anchor it in a very concrete way. And then once we have the concrete, the concept in a verbalized visualized manner, then we can start to put it into the normal symbolic form and the students bring the meaning with them. Into the symbols. Cuz that is the problem is that the students may understand the concept, but then we put it in this symbolic form and it immediately triggers math and they jump back into math class and start behaving like they're there as if these symbols aren't actually directly connected to the thoughts and the concepts we were just talking about. It's just a way to compute.

Mark Royce (22:50):

Yeah.

Brenda Royce (22:51):

Even the mathematical operations can have a little different interpretation in science because of the way they describe how parts come together and connect or join or differences or whatever. These different symbols have a connection to the physical world we're describing, but only if you catch how they relate to the concept.

Ariel Serkin (23:17):

So one of the things that I think as we've been working together on this is considering, first of all, being explicit with our language. So as modelers, we're really explicit with language. I'm very, very careful about the words that I use and why I use them. The other thing is, is that we are, as, as modeling instruction has developed over these years, what Brenda and I are really working on is I'm gonna say I we've never had this conversation, but I'm gonna say we are actually redefining our model right now about how we approach using the mathematics and the physical sciences and modeling instruction that

we had, this one model that we were just using, that we never, we never addressed the mathematics of it.

Brenda Royce (24:05):

We assumed that students understood the symbols we were using. If they came from an experience. Not realizing there just might need to be an intermediary piece in there before we jump straight over to the full on mathematics. And this is particularly evident in chemistry because we cannot visual. We cannot handle the actual objects that we are trying to describe: molecules atoms and so on. And so by giving a diagrammatic thing that talks about the mathematics of it from a conceptual, visual, manipulative manner, it gives access to something that they can't, that they may be still struggling to put the pieces together in the concept itself.

Ariel Serkin (24:56):

Right. This is the one thing that differentiates chemistry from physics is that with physics that people have a intuitive understanding of physics. I can feel something speeding up. I can, the basic kinematics are things that people experience on a regular basis and they have, even those complicated. I'm not saying it's not, but there's a different feeling about it. You're measuring buggies and time. But when we're talking about chemistry, we talk about putting on your molecular goggles and zooming all the way down, but we're making representations of things that we really can't see in a classroom. So because of this, we need to develop a model to bring this to life. And we've done that with these particle diagrams. It's not just modelers. These are, these are chemistry educators and chemistry communicators. And now as we spend more time with this, we need to be a little more careful and spend this time.

Ariel Serkin (25:59):

It's also because as more expert educators, we see these differences. They are inherent to us, but not everybody sees them and not every educator sees them, but by really going back to language, by making it clear what we're looking at and then, and using so our language and using diagrams and symbols, then we can develop the math together. So it's not just us telling, it's not just, you know, do these steps it's we can actually see how all the pieces fit together. As we know, with modeling, we talk about multiple representations all the time. And why do we talk about multiple representations all the time? It's not because we like to torture our students and say, you have to show us this in these multiple ways. It's well, that's a bonus, but because they're all inherent to the understanding. We need all pieces to actually develop that deep understanding of what we're talking about.

Brenda Royce (27:13):

Yes, because these different representations cue different parts of the brain to think about it, different parts of the brain, so that when you get more parts of your mind engaged with it, then you actually start to build connections between the parts of the brain so that it can access, you know, the verbal part can access a visual part, can access a mathematical part cause different things happen in different parts of the brain. And one of the things we need to do is to get more parts of the brain to light up simultaneously so that we can build bridges between them. And we're recognizing that the thing that we haven't been diagramming and including is we have this very abstract mathematical symbol set that we assume students understand, but maybe we do need some ways to bridge that.

Brenda Royce (28:08):

And that came from many dialogues with Rob McDuff, who is a retired professor at Fresno, um, duh, Fresno. That's where I am, <laugh>. At Arizona State University. And, he kind of helped me verbalize some of this and get some tools and things like that. From some things he'd developed with teaching kids, mathematics, cognitive instruction, and math modeling, or modeling mathematics, I'd have to look back. But anyway, Rob helped provide some of the diagrammatic ways of doing that. And we've been working on how do we actually implement that in chemistry? And just because we're chemistry teachers, but you know, they're people who've used this in other sciences. It's just, maybe we needed an intermediary, a secondary non nontraditional set of symbols that capture the ideas more concretely, more visually. So students can learn to articulate them and then add on the symbols again, hoping that they carry the meaning back into the symbols that we need for chemistry. Sometimes it's just really cool particle diagrams that help us do that. You know, we've learned to group molecules when we're talking about reactions. So they see the, for every two hydrogen molecules, we need one oxygen molecule. And that gives us two water molecules by using some groupings in our particle diagram, it gives us a visualization of the relationships. And so this is just taking some things that are harder to diagram and giving us a tool to do it with.

Mark Royce (29:48):

Ariel. You mentioned something a few minutes ago about how many people don't think about these things when they're doing chemistry or even educators. I'm curious as to what you guys know about, across the US are educators thinking this, are they aware of these tools for the classroom? Are they even aware of the need for them? I'm curious what you guys know about that. And then my second part to the question is, is in the workshop, what was the response of your attendees? Did they, was this something, oh, finally, somebody saying something about, or, you know, I'm just curious. So, two parts to that question.

Ariel Serkin (30:35):

I think the first part is, is that there's, there are a lot of conversations that my students can't do math, and they're focused on the problem. And I think the focus is on mathematical without understanding what the real issue, or one of the issues is that they, students just don't really know the difference. And, at least my experience is that teachers are having conversations well, how can we help our students? How can we help them be better? How can we help them figure all these things out? And sometimes the people's reaction is let's take out the math. And what we are saying is no, we need to redefine the math. And when we're looking at the response to the workshop that we did in Indiana and the conversations that Brenda and I have been having with other people and from the webinar on Monday, people are just slack-jawed.

Ariel Serkin (31:41):

They're like, oh, whoa, I need to sit with this because it's a new way of looking at it. Brenda first started having these conversations with me in the summer of 2019. 2019, because Brenda.

New Speaker (32:00):

Blew Ariel out of the water, <laugh>,

New Speaker (32:02):

It's true. I have the pages, I still have the notebook with all the pages of notes that Brenda said, Hey, Ariel, let's put together a proposal for BCCE in 2020 in Oregon at Corvallis, Oregon. And we talked about

it and on the phone. The phone call must have lasted two hours. And I, first of all, I was so excited that Brenda wanted to do a workshop with me because I was, it was gonna be so much fun. And I was just amazed. And then we wrote up the proposal, the proposal got accepted for 2020, and then BCCE in 2020, didn't happen.

Ariel Serkin (32:44):

And then summer of 2021, I don't remember my years anymore. When the proposals opened again, I said, Brenda, do you wanna do this? And, and here we revisited the conversation and we worked really hard together for our workshop in Indiana. And then for this proposal, for the webinar we just did. And the more time we spent talking with each other, besides the fact that we really enjoy each other's company, even if it's across the screen 3000 miles apart, or however many thousands of miles apart it is. Too far. I dunno, California, Massachusetts. We really develop deep, deep understandings together that, you know, you're good. One brain is good, but two brains are better. And it was such thoughtful discussions that we really fine tuned it. And then when we started doing this webinar, it was, oh, we'll just do the same thing we did in Indiana.

Ariel Serkin (33:49):

And they were like, no, we, we completely changed entirely what we did to really focus on what the problem was, looking at this difference between quantities and numbers and relationships and why it's important and how do we see it and how can we apply to not just chemistry, but to physics and physical sciences and how it's applicable to going grocery shopping and all the way throughout. And, and the response to go back to your question, cause I'm not ignoring your question is, is that based on the survey we did, people were like, this is ...people gave us four and fives out of five. And they wanted more specific training. How do I use this in my classroom? How do I have a more content specific? I need to sit with this. I am thinking. Erica Posthuma wants us to write a series of articles for Chem Ed Exchange that people want, people want this, they are craving this. They didn't know they needed it.

Brenda Royce (34:57):

And we didn't realize the huge door we just threw open. So we'll see if we drown <laugh>.

Mark Royce (35:04):

Is there other research going on or other people who are digging into this that you're aware of? Or are you guys kind of

Brenda Royce (35:13):

No, I'm sure. For one, Rob McDuff has been doing it for a couple of decades. I first ran into him in 2004 and I think the inklings of what we are using were already emerging at that time. He did some things at Arizona state. I went to an online workshop that he did. When was that? Like the winter of 2010-11, something like that, where I learned how he does math and how he proposed it. And that's when I learned about how all these, he calls them dots. We were using chips to make it very manipulative. But you could diagram it with a pencil or set of markers or whatever on a whiteboard as well. And I've done some of that with students, but it's out there. I think there are some things in some of the mathematics of...why am I not, are all the current math standards,

Ariel Serkin (36:21):

The Common Core

Brenda Royce (36:22):

Common core. The way math is handled in common core can have some of these elements in it. I think we're recognizing this need to put more concrete stuff with the math. Not just let's give them examples of problems they can solve, but learn the math in more visual, concrete ways. So this is not that we're like breaking the ice where nobody has gone, but maybe adding a voice to a way that it could be handled and tools that we are, you know, we've taken some other people's ideas and developed them in our own classrooms. We've already, like you mentioned, Erica, but some others that have just like, oh yeah, can we have some more dialogue on this there's ideas? Are there other ways that we can think about this? I have a feeling, at least in the modeling community, we may have opened the door to a lot more dialogue with more people. In which case more ideas will emerge, maybe some more applications. 'Cause the two of us can't come up with it all, you know, like I'm meeting with two local teachers tomorrow after school in order to explain the density activity and talk about how it could be used. And we've been asked to write papers. Let's see about that one. <laugh> because it's hard to, how do you put this in paper?

Mark Royce (37:50):

So are you guys planning to do another workshop soon or more workshops or what's your kind of plan for spreading the word here?

Ariel Serkin (38:01):

Um, right now, I'm going to preemptively apologize when I don't respond to text or phone calls for the next month because we're entering my holiday season. So nothing is happening for a month and then we can revisit everything else.

Brenda Royce (38:16):

But yes, there is talk of doing more talk of how we could do this. I happen to have a conversation with my county science coordinator mentioning that we just did this webinar and she's like, like, could we do this in our county? And it's not even a thing yet. <laugh>

Ariel Serkin (38:31):

<laugh>

Brenda Royce (38:32):

So, um, yes, we're looking at ways. And I would love to have a multi-person like almost committee planning kind of brainstorming because it, it needs to be with a small group of people so we can get something that's coherent. That can be disseminated.

Ariel Serkin (38:49):

The one other thing I wanted to add is Brenda said something earlier. By using multiple representations that we make connections to understanding concepts. But there's another part of it that I think is really important. Once you start making connections, your brain becomes sticky and you're able to make more connections to other things. So it's not just that we're making, using all these multiple representations to make connections in a concept. You can then make connections to other concepts. And that is the extended power of what we're trying to do. And, you know, I'll do our other favorite quote, Brenda, is that conceptual competency is required for skill transference. One complaint that teachers always say is

I taught this. Why don't they know it? Or how come they can't like we, we learned this two months ago. Why can't you do it now is because they actually didn't necessarily develop the conceptual competency. And our goal is to develop conceptual competency. So then you can make these connections all the way throughout.

Brenda Royce (40:05):

Yes. One of the things that when you diagram out the mathematical reasoning, what you can show is you just did this, but did you realize that that relationship you have could be any of a number of things it's not specific to a particular concept? So if you have three grams per milliliter, it could also be three meters per second. It could also be $3 per pound. It could also be three jewels per gram. They would all diagram the same. In fact, early on when I first introduced the idea that you can take a quantity, multiply by a relationship and get a second quantity. And I would shorthand it Q times R equals Q in my classroom. I had a student after, I don't know, couple months or so of doing this. He kind of piped up in the middle of class one day and said, man, that Q times R equals Q sure is useful. And it was like, yes, because he was figuring out it was the same reasoning. He was transferring the skill he learned with density or heat capacity or whatever, over to new things like balancing equations and thinking about reactions or stoichiometry or whatever else you may use that is that same kind of proportional reasoning

Ariel Serkin (41:22):

I was having. I have two student teachers this year. They're great. They're gonna be amazing teachers. And... Maybe they'll listen to this. And we were talking at lunch today and they were asked, he said, well, you know that well, when they went to school, their classes were very much lecture and tests and higher education. So lecture and tests, and you know, I did push back, say things are changing. They said, well, are we preparing our students? I said, what we are doing in our classrooms with modeling instruction and this specifically, this way of thinking is we're giving them a real particle level understanding of what's happening. That it doesn't matter if I'm not going to expose them to every single like kinetics equation. Now, all of a sudden we understand how to make connections when things are happening at the particle level, that they have the skills, they have that conceptual competency, that they can do it on their own, that they'll be able to know it and remember it and apply it. And that if they wanna go into higher level science, if they wanna go into the medical fields, but if you wanna go into, if you are gonna be a mechanic, you're gonna be the best, gosh, darn mechanic. You can have because you understand how these connections are made. And you understand that, Hey, if I put that motor oil over there, that's gonna really screw it up because you have this understanding on a big picture.

Mark Royce (42:49):

Wow. So I know that in an audio format like this, you can't really do the training webinar that you guys did because it's so visually demanding, you know, you guys have to I'm sure share a lot of visual stuff. But was the webinar that you just did or BCCE. I don't know -- were either of them recorded, video wise, or can, you know, can people go check this out somewhere if they're interested after hearing this?

Ariel Serkin (43:26):

Why, yes, Mark, as a matter of fact, the recording for the webinar that we did on Monday night, September 19th, has been uploaded to the member portal on the American modeling teachers association website. So if you are not yet an AMTA member, please join, or re-up your membership, and you can watch that webinar.

Brenda Royce (43:53):

And get the slides that we had and other things.

Mark Royce (43:57):

Maybe, maybe worth the price of membership <laugh>

Brenda Royce (44:01):

Plus you get notifications of future webinars. And in case we end up doing another in which I kind of think maybe in the cards, then that would also be announced through AMTA and other social media platforms.

Mark Royce (44:17):

Well, there's a lot of reasons to become a member of AMTA, you know, but obviously one good one is the webinar you guys just did <laugh> so that's awesome. Okay. So if you're a member and you're listening to this you have access to watch the webinar on the AMTA site. Do you know where it is on the site by any chance?

Ariel Serkin (44:42):

It'll be on I believe under the member portal. And, if you wanna keep talking, I'll go find it right now.

Mark Royce (44:50):

Well, if you're not a member of AMTA, I would, and along with many other people, encourage you to become a member, cuz there are a lot of other resources available through that. Your membership there, not the least of knowing when workshops are happening, even the modeling workshops beyond this mathematical reasoning workshop. So get out there and join. Did you find it?

Ariel Serkin (45:20):

I did find it. So when you log into the member portal, and there says member resources are a bunch of green buttons and there are ones that say recorded webinars. So if you click on recorded webinars, you can hear not only our very entertaining, recorded webinar, there will be other ones that have been done in the past as well.

Mark Royce (45:43):

Cool.

Brenda Royce (45:44):

There's some on standards based grading and classroom discourse and you know, a variety of things over time.

Mark Royce (45:54):

Cool. Well you two, this has been a really informative podcast and I I'm excited to share it with our listeners. I wanna thank you both. Ariel, especially you know, it's late at night. I know where you are. You're probably heading close to bedtime. At least I would be at this time. In Massachusetts, but, uh, I really am grateful that you took the time outta your busy schedule to do this. Brenda, you as well. I

know this is gonna be an important conversation and probably open up some more conversation as a result of this podcast. So this episode, so thank you two, and we'll see you soon, Brenda, sooner than Ariel.

Ariel Serkin (46:49):

Thanks, Mark. And it's always a pleasure and Brenda's always fun.

Brenda Royce (46:52):

Yeah. Thank you for letting this message just get distributed one more time.

Mark Royce (46:59):

Well, AMTA has a lot to do with the distribution of this podcast as well. So we're grateful to them and all the work they do... Okay guys, have a great evening. Thank you.

Ariel Serkin (47:12):

Thanks you too.