Frameweld

PaTTAN 2011 PDE Conference

Response to Instruction and Intervention for Math:
Assessment-Collaboration-Instruction

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DR. RICCOMINI: Good afternoon. Thank you. I can tell dead on when I'm doing something on math, because everyone sits as far away from me as possible. Been very glad to be here. I just recently moved back to Pennsylvania. I was in South Carolina at Clemson University for nine years. I'm back in Pennsylvania.

I originally grew up in Erie, and I did most of my teaching in the Erie School District. I don't know if there are any Erie contingencies here. So you made it down in this massive snowstorm they got down here. Right? Flurries in northwestern Pennsylvania is what we call what we had today.

But I'm very glad to be back here in Pennsylvania, and I'm currently a professor at Penn State, and my main focus is really trying to work with teachers, whether they're special ed teachers or general ed teachers, in terms of improving our math instructional programs.

So in the two-hour session today, I sort of have it broken up into three components. The first brief component is just the, I'm going to briefly talk about RtI. Now I'm going to spend, I'm going to go through it quickly, because everybody in this room knows what the components of RtI are in mathematics, because they're exactly the same components as in reading.

You have an assessment, which has two components, universal screening and progress monitoring. You then have instruction/interventions, and you have a tiered approach. As kids move through the tiers, the instruction becomes more intensive and more systematic, and then you have some types of general outcome measures to evaluate that progress.

And sort of an end result of an RtI Model would be a determination for special education. So, I mean, there it is in a nutshell. Now where everyone's running into challenges in math is what do I do? What do I assess? What do I progress monitor? How do I make this happen? When do I move a kid up, back, and so forth?

Now there's a lot of those questions that we're not exactly sure what the answer is, but bottom line is when you look at all those different components, the most overlooked component, in my opinion with RtI, it's probably the most under researched as well as under addressed at the school, is what the teacher is doing in the classroom with instruction.

And that's my entire slant on it. I don't, it is, in my opinion, there is any number of assessments that can be used, and you can do it twice a week, you could do it once a week, you could do it twice a month, but if you do not, if we do not, as a field, examine how we're teaching math, then what we're going to conclude, once again, is that we're not doing a very good job for a large percentage of kids.

So my major slant revolves around instruction. Now in a lot of the sessions, you're hearing things about the Common Core, or you're hearing things about the various assessments that are in place. Those are the standards. In other words, that's what we have to teach, and that is very, very important. And we have to go into more rigor and, etc., etc., but that is not going to improve learning, if we continue to teach those standards the way that we have been teaching math if that makes any sense.

If we keep teaching math the same way, then we're just going to get the same results. We're just going to have it in a different framework for standards. So my main focus and sort of slant on this whole RtI process, RtII, is the idea of instruction. Instruction matters.

So, sort of that I break up the two-hour session that I have. There'll be a brief overview of RtI, a little more depth of what I've just covered. Then we're going to move into the research in terms of instructional recommendations that teachers need to do. Now this is at all levels. Now I probably have, it's elementary teachers in here. Are there any elementary, middle, high school?

And then there's some, there's probably some administrators. There's some instructional coaches, some IU, and so forth. Regardless of what level you are working with, we need to improve instruction at every tier. And if we put all of our efforts into Tiers 2 and 3, we have a fatally flawed model, because those tiers all build upon which tier? Tier 1.

So that's sort of the idea here. I mean, so overview of RtI quickly, and then we're going to talk about instructional recommendations. And then I'm going to take you through a couple of modeling of specific strategies, two of which you could start doing tomorrow if you wanted to, if you have school, or after your two-hour delay or whatever, and the other ones are things that we have to think about.

One of the things that's changed in things that I've been doing, is I started to do a lot of, for lack of a better word, of coaching where I'm going into classrooms and observing math teachers and providing sort of coaching or recommendations. And I saw lots of really, really good things.

But by and large, one of the things that was most shocking to me was we're still basically teaching math the way we've always done, which is we're showing kids how to do problems, and then we're expecting them to immediately transfer that onto another problem. And there's an awful lot of support, or scaffolding is a term I use a lot, that we can do in place.

And some of it is going to take the way we all have been trained to do math, sort of breaking our habits as far as what we think math is, because where are my math teachers at the high school level? So we've all been basically trained that when we see a math problem, what do we have to do? Solve it. All right. Start to where? Finish.

And that is one of the things that, there's where's a lot of room for instructional techniques and strategies that we can do to facilitate the learning, and that's sort of how I approach it. When you're working with kids that are struggling, they have lots of issues, and as those kids get older, those issues get more magnified.

When you're talking about kids with learning disabilities, they have even more significant issues. And it's going to take sort of a concerted effort, but we've got to start teaching math more than just showing. And that's sort of what I see, have seen a lot of.

So we're going to, we'll move through the session. Any questions? I don't know if someone's going to go around with a microphone, but if not, I'll repeat the question since it's a large audience. But please ask questions if anything should arise, and I'll try to explain it.

But part of the issue, and I don't want to, basically, we've got a problem in the United States, and it's not just kids with disabilities. Our average to above average kids in math are not doing very well at the international level, and that's created a whole lot of discussion about are we ready for the next technological advances, the workforce, the whole nine yards.

And a lot of people are worried. But the trend that we see is highlighted right here. Now you can look at this in terms of, man, 15% are below basic, or you can look at it as, well, 85% are above basic. So it's not that it's a complete failure, but the trend is where we're having the issues.

As kids get older, more and more kids what? Do worse in mathematics. So that's the NAEP. If you look specifically to kids with disabilities, and this is really shocking, basically, at the high school level, almost all kids with learning disabilities are below basic, essentially, which kind of makes sense, because they have a learning disability which says they're significantly behind.

But bottom line is, way, far too many children in the United States are not at levels where we need them to be, and that's sort of the premise. Now I can show you these different things. When you start looking more instructionally, and the Common Core Standards is really trying to address, because if you've only worked in Pennsylvania, your main frame of reference is Pennsylvania.

But I've started to see various states, and the math content is the same. In other words, if you go in any state, you're going to see kids learning about fractions or quadratic function and so forth. The issue is where they're learning that is all over the map.

And with the Common Core coming out in Pennsylvania, we're going to have a little bit of a wakeup call in the sense there's going to be a lot of things getting moved down that we're just not ready, we're just not accustomed to doing. So it's going to take some, a learning curve on our part.

But fractions is one of the biggest issues, and fractions is really a byproduct or sort of a sub-skill of rational numbers, and it includes ratios, proportions, decimals, the whole nine yards along with that. And fractions is, becomes critical, because later on, ratios and proportions is basically how we, what we use to solve an awful lot of math problems, whether it's in a book or in the real world.

And, of course, that leads into geometry and measurement . . . also a part of this whole application piece. We have a lot more kids having to take remedial classes in college. So these are kids that are getting into college. So, in other words, they're doing everything they need to do. They have high high school GPAs. They tend to do well on various assortment of tests, but when they get into college, they have to take remedial math classes.

So we're seeing this whole like hodgepodge of things that are really impacting what we're doing. Now this is a slide that should be scary to everyone out there. Seventy-eight percent, so over three-quarters of adults, so forget about the NAEP and AYP. Okay. That's statistics and so forth. Those kids that are below basic or barely basic, when they enter the real world, these are the things that it means.

Seventy-eight percent of adults cannot calculate interest, or cannot explain how interest is calculated on their loans. Okay. That's not calculus. That's really not even algebra. That's usually about a sixth or seventh or eighth grade math level skill. Seventy-one percent can't calculate miles per gallon. Now that gas prices are going back up, it's just we don't want to calculate the miles per gallon.

Fifty-eight percent can't calculate a 10% tip. I don't know if you've ever been in a situation where you're out with a bunch of people, and they can't divide up the check. So then the check comes as one. You know that whole fiasco of trying to figure out?

Well, they usually slide it over to me, because I'm the math person. Well, guess what? I make sure I come out the lowest regardless of what I had to eat, and, really, no one really has any idea. So, you know, this is sort of the end result of these basics and below basics year after year after year, and this is what we're trying to sort of resolve.

And a lot of this just has to do with the logical application of math concepts and principles, and that's really what's happening, or that's one of the driving forces in terms of workforce and labor force and all those types of things. But when you start looking at the components of RtI, numbers two through seven are standard. They can be applied to anything that you want to do RtI, behavior, reading, writing, math, etc.

But number one, I have specific asterisks beside number one, because this is where a belief system by us educators really plays into it. Our culture, our society that we have, it is really still, to this day, accepted not to be good in mathematics. All right. If you're a bad, if you're good in math, that usually has some negative stereotypes along with it.

Oh, you're one of them or a geek or a dork or all those negative connotations, where we don't have that necessarily in reading. But there's a belief system, so that's the first thing. The second aspect of this belief system is we really have to believe that the close to 100% of kids, all kids have expectations to do well in mathematics.

And often this is referred to as people think there's a DNA math gene out there. And early on, well, you don't have it, and you don't have it, or you see it in parents. If you've ever taught for any length of time, and you get parents in there, and you've got the kid there, you've got the parent there. Oh, I can really start to focus. And what does a parent say when talking about math?

Well, I was really never good in math. Do you really need it? It's just, the entire system we have is really working against us. We have to sort of combat this issue, but we've got to start with the teachers. Now on the other, on the flipside of this, we also have a unique situation in math that is different in reading, and it has to do with the teachers and their level of confidence in mathematics, most importantly, at the elementary level.

And what I mean by that is, if I went to a high school literature classroom, and I pulled out a Shakespeare book and brought it down to the elementary school, every one of those elementary school teachers could what? Read it, discuss it, comprehend it, etc.

But if I go next door to that 12th grade calculus class or even Algebra 2 Trig or even Algebra generally and brought that content down to the elementary school, how many elementary school teachers would be gung ho, confident, and super excited to do that math? All right.

And I'm not blaming elementary teachers. That's the system we're in. Now the flipside of that are the high school teachers who are content savvy or content knowledgeable but are often least open to changing how they what? Teach. So there's two sides.

Elementary teachers pretty much will do whatever you want, especially if it involves sitting on the floor or those types of things. But so it's a system we're in, and I'm not criticizing or blaming teachers, but in order to move forward, we have to know where we're at. In other words, we have to know our weaknesses, so that we can then focus in areas of improvement.

So at the elementary level, one component of any effective RtI Model is to make sure that you are providing some level of content professional development. In other words, learning more about fractions, learning more about rational numbers, the content of what we're teaching.

Because if elementary teachers don't know why they're teaching certain things at the elementary level, it leads to a disconnect, and it ends up being kids going through the motions and not really understanding the long-term sort of progression. And at the high school level, we've got to start looking at changing how we teach certain things, and I'm going to talk about some strategies that I see absolutely no reason why high school teachers can't try some of these particular strategies.

So we're starting to move through this. But these are the core components, and I'm going to sort of, instead of getting into the detail about this, I'm just going to phrase it in these systems. Universal screening, there are many different assessments out there at the elementary level, about K to 6.

Once you get into middle and high school, the number of research-validated progress monitoring assessments gets greatly reduced. All right. So there's some question of what to do, but there are things out there. My recommendation is absent of high quality research on any particular measure, every school has to, so to speak, do a research study.

In other words, pick an assessment, progress monitor, and look at how well that predicts success at the end of the year. The instructional tiers, Tiers 1, 2, and 3 in Pennsylvania, and understand the main piece with the tiers is that kids can move up and back based on their instructional needs.

Here is the one question that all districts or schools, whatever level you're at, must ask regarding their tiers, and that is, how effective is it? And the question that you want to ask, among others, is how many kids at the beginning of the year entered Tier 2, whatever that is? It could be a computer program. It could be an intervention delivered by a teacher, commercially available.

It could be problem solving, where the teachers are kind of figuring out what they want to do. It could be an extension of what's happening in the current classroom. But for Tier 2 to be effective, a large percentage of kids that enter Tier 2 should eventually what? Go back to Tier 1.

If you have 100 kids that go into Tier 2, and at the end of the year, there's 100 kids in Tier 2, and then you go to the next year, and there's 100 kids in Tier 2, then guess what? It's not working. All right. Now notice I didn't say exit all of those kids, because, really, there's this kid that's appearing, this profile of kid that, when they get into the second tier, makes appropriate progress.

In other words, that tier is working, but it's not catching the kids up. So we're seeing a child out there, you could have a group of kids that they need Tier 1 plus always Tier 2. So you just keep that in mind. A good Tier 2 program will exit kids, in other words, catch them up and drop them back. They don't need it anymore.

We don't really know what a good percentage is, but if 100, you know, if you're exiting 2% or 3% of the kids, then you've got to question what this, how effective this is and all these sub questions. Well, how much money are you spending? How much resources are being used? All of these things have to be addressed at that, sort of that Tier 2 level.

Now the good thing is we're not anywhere close to reading, but there are a lot of interventions that are now starting to come out onto the market, so to speak. But keep this in mind, very few of them are scientifically validated. Some of them are evidence-based, all right, so you've got to be very critical of what you look.

But the biggest impediment or barrier to doing a Tier 2 intervention program, let's see, is what? So Tier 2, the kid's going to go get a commercially available intervention program. Someone's going to deliver it to him. What's the biggest issue there? It's not money, believe it or not. It's the time.

These interventions that are coming out are requiring anywhere from between 30 to 60 minutes extra, all right, and that's the biggest issue. Well, where do we get this time? What is the kid not going to get into? That is the biggest issue. There are interventions. Some of them, I think, are very well designed, but it requires time.

And that's sort of the, one of the biggest issues that you're going to run into. And just like reading, when kids struggle in reading, the National Reading Panel said all kids should get how much instruction, minutes in reading? Ninety minutes. And when kids struggle, they should what? Get more.

Well, the exact parallels are being drawn to math. Whatever they are getting in math, they need to get extra. Now that brings up the next question, which is, how much time are you teaching math at the elementary level? Minimum of 60 minutes. And I know there are some places that are not doing 60 minutes. Minimum of 60 minutes.

When you're not doing, when you're not spending the time, I've gone in the school, they go, man, our reading scores have improved so much, but our math scores are flat. How much time are you teaching reading? Oh, we're teaching 120 minutes of reading, etc., etc. Well, how much time are you spending on math? Well, 50 to 60. Well, that's one big variable right there. Time is a crucial variable.

Research-based instruction and interventions, unfortunately, we do not have enough research done in mathematics that's anywhere close to reading. So we're significantly behind. In reading, there are hundreds of interventions, adolescents, middle, hundreds that go down to very specific skills. Where in math, there are lots of things out there, but very few are research-validated interventions.

Then number seven is another biggie for math, is in all RtI, but particularly in math, is once you pick your plan, you have to evaluate it. In other words, are we reducing the number of kids that we're referring to special ed? Are we capturing the struggling kids at the high school level and catching them up?

And if not, the plan should be fluid in the terms that you're evaluating it every year. All right. So four core beliefs, and these are the things I'm going to move quickly through, because this is sort of the foundation. All students can be mathematically proficient. I tend to agree. I don't see why we cannot get kids, almost all kids proficient at least through Algebra 1.

And when you get up into the upper level grades with algebra, that's where it's going to take a lot of effort. But, folks, everyone's all bent out of shape about algebra and so forth. We're not getting half of the kids proficient at third grade, fifth grade, sixth grade, so we've got to do a better job at all avenues.

But when you start looking at algebra, until you get into the linear functions and the graphing and those types of things, a lot of algebra is nothing more than a computation type of manipulation applied more in a logical thought process. Number three is where, is a biggie, and this is where the Common Core Standards are coming into play, this whole debate, math wars, whatever you want to call it, about is it the concepts, is it the application, the problem solving, computational, factual?

What is it that makes kids proficient in math? And what we're sort of, we're sort of having some consensus here, and what it really is. It's the blending of all of these components that make kids proficient. In other words, it's not just concepts and problem solving and computation, but they are all interdependent.

Oftentimes, problem solving is the application of concepts and computation. So in order, you have to think of it as a progression, but these are the things we need to address. If you're spending all your time on concepts, then that's going to end up having a problem in the end. If all you're doing is computation, naked math problems, that's what I call them, just numbers, then you're not getting to the rigor that we need.

So it's these components together. And then the fourth one, which is my main, I should have a license plate made of this, but it's instruction matters. That is the key. There is no magic pill. There is no computer chip to be imbedded behind the back of the ear yet for algebra and geometry. It's going to be the instruction. And that's where we have to really focus in terms of teach at the teacher level.

Now universal screening, I'm sort of moving through these, universal screening is generally three to four times a year. The purpose of universal screening is to identify struggling kids to get them additional instruction, not to get them out of your class and into special ed. It's to get additional instruction.

Then you have progress monitoring. Universal screening can be the same as progress monitoring. Finding good progress monitoring measures at the high school level is a little bit more challenging, although there are some out there. I believe Pennsylvania participated in the piloting of one of those at some point.

The key with progress monitoring, minimum, once a moth minimum, twice a week, or, I'm sorry, twice a month preferably. The idea is that teachers are using that information to make instructional changes. The tiers, the arrows have, on both sides you have the flow up and flow down as necessary. Generally speaking, as students move through the tiers, the instruction goes to smaller groups and is more intensive.

You see, I've seen anywhere from Tier 1 should address 80% of the kids' needs. Tier 2 should be 10% to 15%. Tier 3 is in a small 5%. Here's, bottom line, whatever the percentage fallout to be, if more than 30% to 40% to 50% of your kids are requiring Tier 2, then your Tier 1 is broke. Everybody understand that? That's a key.

If you have excess of 30% to 40% to 50%, then that means you need to first and foremost address what you're doing in the Tier 1 classroom. All right. Let's see. I want to get to, here's sort of a summarization. Research-validated practices, where we have them available, everyone is involved. It's not just special ed. It's not Title I. It's not IU folks. It's general ed across the board. Collaboration and consulting about data and so forth, and, really, everything goes down to student performance.

Is it working? And if it isn't, what are we going to do next? And that's pretty much where I focused on RtI. I haven't really gotten into the eligibility issues as much as, okay, so kids are struggling. What are we going to do? That intermediate step prior to any determination for special education services.

So that brings us to the National Math Panel Report. Now before I get into this, are there any general questions about the components of RtI? In my opinion, that should be nothing awe. There should be no ah-ha moments there other than now it is how, those are the components of RtI in general.

Now the Math Panel Report, how many of you have read the Math Panel Report? Okay. That's not a good thing. All right. I'm assuming that you're in here, because you are responsible for math instruction at some level, either supporting or actually the delivery. This report was similar to the National Reading Panel Report that came out that was so influential.

Now one of the reason why it was influential was they had Reading First monies attached to it. But in this panel, if you haven't looked at it, you should download it. It addresses a lot of things. I'm going to specifically pick three of them. But you should download it, take a look at it, read it, the odd and the even pages. I know we're math teachers. Sometimes, we like to do odd or even. You need to read both.

But in the documents that I provided PaTTAN that are on the website, there's a two-page summary sheet on there that's bulleted. If you printed those off, it's in the supplemental handout, but it's just the factsheet that kind of bullets it, and you really need to take a look at this.

This really needs to drive when you start deciding what you're going to do for the interventions. In other words, you need to evaluate what your interventions based on what the Math Panel has been recommending. Now when you look at this, if you have the handout, this is the most important, in my entire two-hour workshop, this is the most important slide, and it has to do with the working memory piece.

Now the first bullet there has to do with what makes kids proficient in math, and it's the idea of we have to take time to teach concepts, problem solving, computational fluency. The Common Core Standards have fluency throughout. This is not just basic fact fluency. This is once kids learn how to do fractions and the concept of it, and they understand it, they need to become fluent at the manipulation of that.

But the second bullet, this working memory, if you take into account working memory, you will be a better math teacher guaranteed. This is where we math teachers are making the biggest mistakes in terms of how we're trying to teach. Now what we're seeing is kids that struggle in math, now especially kids with learning disabilities, it has been 30 years documented that kids with learning, identified learning disabilities have significant limits in their working memory. Okay?

What we're seeing is math, the way we've been teaching, is a byproduct of children's working memory. And when they have limits in their working memory, that impacts what they can take in at one time. And we have to recognize that in math, we are talking about multiple things, I don't want to say steps or procedures, multiple things happening at once.

Concepts, vocabulary, rules, procedures, application. And we're asking kids to blend it all together at once. Now what, I want you, I'm going to pose a question here, and I want you, what is the first thing that pops into your mind when I pose this problem-solving question?

We've all put puzzles together. Right? What's the first thing you do when you put the puzzle together? Show me with your hands. Everybody's doing this, and you're all wrong. Okay? That is not the first thing you do. Guaranteed that is not the first thing you do. You do at least three things prior to that.

Now when you said this, I'm assuming that you put the edges together, and you work your way what? In. Right? Where are my, are there kindergarten teachers in here? All right. What's the first thing in kindergarten you're teaching kids to do with puzzles?

WOMAN: . . .

DR. RICCOMINI: Thank you. Out of the box, and the key is, turn all the pieces what? If you're a kindergarten teacher, you have seen kids trying to jam together pieces. Now why? And this is why, like I said, if you leave here with this mindset, you'll be a better math teacher, why is it that when I said what's the first thing you do, almost all of us in here jumped to I do the edges first? Because you assume.

I don't even think you put that much thought to it. Because we're automatic on those first three things. Okay? We don't even think about it. In other words, it's so automatic to us, we wouldn't even think going to the assumption that, well, they should know that. All right. Now what does this, how does this connect to learning?

Because we're automatic at those three steps, we use no what, of our what? Working memory. It's all free to focus on the what? Putting the puzzle together. And that when, so as math teachers, we have to recognize there are a lot things that we're doing automatically, that we need to somehow make overt or explicit to the kids, whether that is directly stating it or providing some scaffold or something for the students.

Math teachers, there are so many subtle things that we're doing, that we need to make sure we're teaching that to kids. So this working memory is key. Now the report says there's ways that you can help kids with working memory. One of them is to providing them, and this is key here, structured, focused, and strategic practice. Okay?

This is not 60 problems on a worksheet, drill, and kill. All right. It's distributed. It's focused. It's strategic, and it's in short bursts. That can help kids become automatic. When kids become automatic on certain things or more fluent, that frees up their working memory. And this is a key. Where are my third grade teachers? Are there any third grade teachers in here?

Third grade is generally where division is introduced. Is that correct? I'm not 100% versed yet in Pennsylvania. Somewhere in third grade, maybe the end of third grade beginning of fourth grade, the concept of division is introduced. It's developed. At some point, you move the kids to the procedure that you want them to use, whether it is a standard algorithm or the lattice approach, or whatever it is.

How many steps are involved in that basic long division problem, absent of any problem solving or application? I can guarantee you that it's more than seven. Most individuals can remember seven pieces of information, plus or minus two, at one time. And we're talking about kids who struggle, who have limits in working memory.

So as math teachers, when we're explaining this whole problem, recognize kids are basically hearing your first explanation, and then they're missing everything in the middle, and they're hearing the last thing you say. And what happens is that's where the teachers say, well, the kids don't even try. Well, they don't even try, because their working memory has been what? Overloaded.

Now I'm going to talk about ways that you can try to address that. One of them is that you make sure they become fluent or automatic at certain pieces. And the area that's generally most discussed is with basic facts. All right.

When you have a kid in middle school, fifth, sixth, seventh grade, or high school for that matter, and he's faced with a basic multiplication problem, and he's got to pull out his fingers, take his shoes off, lick his fingers, pound his head, whatever, sing a song, jingle, or whatever, that is using up his what? Working memory.

Therefore, he has less cognitive processing capacity to focus on the what? Concept application. So, generally, at the elementary level, one of the things you have to address in any RtI Model is what are you doing to get kids to automaticity in basic facts? And what I have experienced, and I think this has been a big battle here and there, this is one small component of math.

We generally do a lot, spend a lot of time developing all of the operations using number lines, manipulatives, concepts. Then we spend time on sort of relationship activities like doubles, times one, times zero, commutative property, fact families, those types of things. And then we spend a decent amount of time giving kids strategies, counting on, then you have the arthritic predicting nine strategy.

You're all, kids are going to have arthritis by the time they're 20 with that. Okay? Those are fine and dandy. But at some point, they have got to get past that. Because if they have to default to a strategy every time, that's again, using up their what? Working memory. And it's very, draws a lot of parallels to reading.

For those of you that are working with poor readers, they generally, when they read, they're very what? Slow. And they're focusing an awful lot on what? Each word. Sometimes each letter sound. So even though they read it correctly, when they get done reading and you ask them, because that's the purpose of reading, comprehension, what did you read? They have what? No idea, because all of their working memory was focused on what? The word level.

Now when you get into middle school and high school, you start talking about systems of equations, all right, you know the whole concept of systems of equations, thinking, or quadratic formula, any of those things. You are talking well in excess of 10, 15 things happening. So this instruction of showing the kids, even though you do it three or four times, recognize that you are overloading their working memory, and once it's overloaded, they're not learning anything.

And we have to start taking and chunking information into manageable pieces or doing some scaffold to take some of the taxing of the working memory off the table. One of the things that I, as a decent strategy in this realm, is most math teachers, we chunk across problems. So we model problem number one, all of the steps. Right? It's pretty traditional. I see it all the time.

Second, we go to the next problem, and what do we do? Model all the steps. Maybe we ask some more questions. Third problem, we're modeling, maybe asking some more questions. Then the kids do guided practice on three problems, and then the guided practice basically becomes the model, because the kids can't what? Do them. And then there's an independent practice.

So we chunk within problems. A different approach is to chunk across problems. So you have your three models that you're going to use, save a fourth one over here at the end, and instead of going through each problem, you go through the first chunk of the first problem. Then you go to the second example, and you show them this first chunk of that.

So now they're hearing the first part what? Twice, back to back. Then you go to the third problem, and it's more guided questioning type of thing. Go back to the first problem. We just did this step. Now the second step is this. And then they get to see it.

Now I said you want to save a fourth or a fifth problem, because the chunks have to get what? Bigger to the point where the kids have to see a problem or do a problem what? Worked from start to finish. This is a progression. And if you go to any, athletics dominates this country, if you go to any athletic practice, you will see progression after progression after progression, even in Joe Pa's Penn State football practice.

And the progression is they focus on the parts, and they work their way to the end result. And in math, we are not doing that at all. We're start to finish, and we're killing the kid's working memory. On top of that, if they have issues with computation and basic facts or vocabulary, you're saying the numerator, and they're like is that the top or the bottom number?

Then all of that is impacting their learning. So this chunking across problems is a very different approach that is a form of scaffolding to sort of get kids to where we want them to be at the end. And that can be done with anything that involves multiple steps. And most everything in math is multiple steps, because you're talking about the application. So that's sort of your first strategy in terms of the chunking issue.

But if you consider, basically, anytime you're about ready to teach something, you should look at it, and we're math teachers, so we're good at it, you should literally write down all of the steps and take that into account. In other words, what is it that kids have to do to solve this problem, and then take that into account and form your chunks from there.

Now how you form the chunk depends entirely on the students. Some kids need much smaller what? Chunks. Other kids can get larger chunks. But if you take this into account, this in and of itself will make you a better math teacher, because this is how you try to facilitate learning.

We have been, since the invention of algebra class, middle school math, we have been showing kids from start to finish how to do problems, and that we need to do chunks. Now notice within that progression, it can be very explicit initially, or it can be guided. You have to make that decision based on your kids. Just recognize, kids that struggle generally need more what? Guidance, explicitness. So that's the working memory piece. Are there any questions on the working memory? Yes?

WOMAN: . . . problems. Say you cover the other two up. I would think like, for myself, it would bother me if that first problem is still hanging there. I don't know what to do with it, yet she's taking me to problem two.

DR. RICCOMINI: Yes. When, well, first off, very specific things and how you set the lesson should always be based on your kids, all right, and every kid's going to be different. But when teachers I've worked with that try this, they say, initially, it kind of freaks the kids out, because they have never seen that.

What they have always seen is what? First problem, second problem, third. So you need to have a discussion with the students. This is what we're going to do. Now, remember, I'm never of the belief that it's going to, one thing's going to work for every kid, so you've got to make that judgment. But have a discussion with the kids, and explain to them why you're halving problems up.

Now when you have that discussion with kids, you're helping them become more strategic. Most good mathematicians, we tend to look across multiple problems in terms of going from one, we look for connections. So to answer your question in sort of the middle of the road, yes, it can freak some kids out.

It's sort of uncomfortable to some of us, because it's totally, it's an entirely different instructional approach than what we have learned, and what we've been programmed to do. So you need to have a discussion with them. If you think it's best to cover it up, that's fine. But the idea is we're trying to break the habit of teaching problems in isolation, which is what we do a lot of.

This problem, now it's erased, now it's this one. When, in reality, we want them to see across problems, across problems. Any other questions on working memory? It is a major issue as problems get more complex, starting as early as second and third grade.

The other thing, by chunking it across problems, you'll begin to see where specifically in the problem that the kids are making their mistake or erring or getting stuck, which then will allow you to better focus in that particular area. Now as far as instruction goes, you have these two terms out there, student-centered, teacher-directed.

Neither one is supported as the only way to teach when you look at the research. So in mathematics, there needs to be a balance. Some things need to be directly taught. Other things can be more explored, student-centered inquiry, whatever you want to call it. But the idea is, in mathematics, is you need to think of a sliding sort of, again, the word progression.

We want kids to be able to do inquiry, discovery, application, problem solving, so we need to get them to the point where they can engage. A lot of times, with our kids, they won't even engage in those types of activities, because they don't even know how to start. So we have to have a balance there, and that's key. Now I'm directly speaking about Tier 1 right now.

Your Tier 1 Core Math Program needs to have a balance, and the programs that are out there, some are sold as this is exclusively a student-centered approach. To me, that's ridiculous. We should all be a learner-centered approach. What the learner needs, the learner gets.

But Tier 1 needs a balance. Everybody needs a balance. Now some kids need less or more on either side, but when you start talking about kids that struggle, what the math panel basically said was three sub groups of kids, now we're starting Tier 1 moving Tier 2 kind of things, Tier 1 and Tier 2, kids that struggle.

Low achievers have difficulties or have learning disabilities. So is there anybody here from a school that doesn't have any of those three sets of kids? I always have to ask, because if that's the case, I want to go check it out. Low achievers, now I'll make the argument that at some point in a child's math career, except for about 5%, at some point, kids will struggle.

Everybody generally struggles in math at some point. But low achievers have difficulties in math or have learning disabilities. Does anyone come from a school where they don't have any of those sub groups of kids in Tier 1? So I just want to make sure I understand this. Everybody in this room comes from a school or works with schools that have these three sets of kids being educated in the Tier 1 classroom. Yes?

That means part of that instruction needs to be explicit, needs to be clear in terms of how you want the kids to problem solve, must have very carefully sequenced and organized examples, have appropriate use of concrete or visual representations to help kids see abstract procedures. Anything that you're doing that's a manipulation is abstract for the most part.

And then, finally, we need them to think aloud. And this is another thing that I saw an awful lot when I was observing. Teachers were doing rather sophisticated think alouds. In other words, they were modeling very high-level types of thinking aloud and asking high-level questions. Very good.

WOMAN: Can you give an example of that?

DR. RICCOMINI: Of what?

WOMAN: . . . thinking aloud . . . specific thinking aloud?

DR. RICCOMINI: For concrete?

WOMAN: No, no, no . . . when you just said teachers are doing sophisticated thinking aloud examples.

DR. RICCOMINI: So when I'm observing classrooms, and I'm listening to what the teachers are saying, they're getting into depth. They're doing very good think alouds. Okay? In other words, they're modeling whatever it is the kids are trying to learn, and they're doing it very well.

But what I didn't see are students getting the same opportunity to do those think alouds under some type of guidance. Generally, what happened was that teachers would explain something, and then they would tell the kids to what? Ssshh. Do the next one. All right. Now in a second here, I'm going to show you how to do a guided think aloud. Yes?

WOMAN: I have some kids . . . but then the other kids are like, ssshh . . .

DR. RICCOMINI: Well, again, you have to reach a balance, and, I mean, you're right. Some kids are going to be distracted, but you've got to reach a balance. Kids need the opportunity to think aloud. If I go to any elementary classroom in here, and, or even in an English class where they have to do writing, in essence, when you write something, and you turn it into a teacher, and that teacher reads it and then gives you feedback, they're seeing you do what? Thinking.

In math, looking at a problem solved is not getting at the kids' thoughts as much as we need to. So, yes, there's got to be a balance. Sometimes there should be quiet in the classroom, and they should be doing independent work. But what we need to do is more opportunities for kids to think aloud, and I'm going to show you a way to do guided think aloud.

But these are the things that need to be taken into account. So when you start looking at interventions, Core Programs, supplements, interventions, you want to make sure if you're picking a Tier 2 intervention, you need to make darn sure that that intervention is aligned with these characteristics.

In Tier 1, you need to make sure that that Core Program has some of these things built in, or you have to supplement. I'm not one to say, oh, that program stinks. Throw it out. But what's its weakness, and how can I supplement? But if you're in a school district at the elementary level that only teaches math 50 to 60 minutes on a good day, and you have a Core Program that doesn't address some of these things, and now you have to supplement it, you're going to run into the time crunch.

And then you're not really doing the core, and you're not really supplementing, and it becomes a hodgepodge. So, I mean, these are some questions that have to sort of be addressed. Now there's another document out there that if you haven't looked at, you should look at. It's an IES document. It's an RtI Practice Guide K to 8, and they have eight recommendations.

The third recommendation is any instructional tier needs to have explicit and systematic, which means increasing the modeling, the demonstrating, the guidance. Now there's different ways you can provide guidance. You can do it yourself as the teacher, or you can build materials that provide some guidance.

But, generally speaking, when you start talking about, well, what do we know about how kids who struggle learn, what we know is they need to have a little bit more explicit instruction, but that doesn't mean exclusively. So when you start thinking about your tiers or programs or computer programs or whatnot, you need to take into account is it explicit? Is it providing lots of opportunities to respond, to engage, to participate?

Is it providing the rigor that we need? We cannot just glance over things. We need to get really in depth. This is really going to come with this Common Core in terms of the tasks that kids are going to be asked to do, or teachers are going to be asked to facilitate. Bottom line is explicitness, focus on problem solving, the verbalization or thinking aloud, and then the frequent cumulative review.

So when you start looking at Tier 1 and Tier 2, it should capture some of these pieces, unless you're in a school that doesn't have anybody who struggles in Tier 1, some of these pieces, and then that flows into Tier 2. And then, of course, Tier 3 is going to get even more explicit.

So within your RtI, all those components, essentially it boils down to this neat little . . . diagram here. You know, we're trying to get all kids proficient, but when you start looking at RtI, it's really a systems approach. In other words, it's not at the teacher level necessarily. It's not at the district level. It's a systems approach, and the three main components to this system are your curriculum.

Now your curriculum in Pennsylvania, or your standards, which is going to be shifting to the Common Core, so first and foremost, teachers have to know the standards. You have to live in them. As special ed teachers, that could mean you have to know multiple grade levels of standards. Then you have a material or a textbook or a program that's delivering those standards.

Now I think one of the byproducts of 48 of the 50 states, or the majority of states adopting the Common Core, is you're going to have programs available that are very well aligned with the Common Core. Right now, basically, textbooks are setting up their programs in relationship to about three states.

But with this Common Core, you would think we're going to have some better math materials in terms of that they're more aligned with what we're teaching. You have your assessment. Now you have your end of year assessments, you have your standardized assessments, but, also, what are you doing? Progress monitoring. Do you have benchmarks? What is it that you're doing?

The key is the assessments need to be aligned with the standards or curriculum, and most importantly, teachers need to look at those assessments and make decisions in terms of how they're teaching or what they teach.

The bottom one in this, I don't know, lime-ish colorish puke yellow there, I don't really like that color, but, anyway, is at the bottom of this, not to intend that this is low level, but the most critical feature of math achievement is really boiling down to the teacher and how they teach.

And we don't really know if it's the content knowledge of the teacher or if it's the strategies. It's going to be a combination of both. You know, if you can't do the math, you can't teach it. But just because you can do it does not mean you can teach it. All right. Yes?

WOMAN: . . . departmentalization . . . and also model . . . all of that is not making sense . . . so there's a discussion about should this . . . school, because they have . . . feels very strong . . . skills in this area be that . . .

DR. RICCOMINI: I'll answer it this way. I am generally in favor of that approach. We don't have a lot of research yet that says that is validated in a way we should move to that. A lot of other countries that we're being compared to generally have a department, in other words, they have one person teaching math even at the elementary level.

I've been in a lot of states that are, I've seen departmentalization down to second grade. That's the lowest grade I've seen it. But that's a discussion that, in my opinion, it makes sense that if you narrow down what you're responsible for teaching, you should be able to teach it better. Right now, in our, I mean, just common sense tells me that.

Right now, elementary teachers have to teach what? Everything. Okay. So that is, I think that should be a discussion point. I think if you go to that, I have seen a dissertation that looked at that. Now I'm being specific that it's a dissertation. It's not been peer-reviewed. It's not been through a rigorous evaluation. And they seem to think that it was a good idea in terms of impacting student achievement.

It's a discussion that I think is worth having. Understand you have a lot of issues. A lot of elementary teachers are dead set against having kids move, or they're still in the mindset of, well, they're my kids. I need to do it. But I have seen it down to second grade, and I think common sense tells me that if there's an elementary teacher that says, man, I really like math, that probably tells me that they're comfortable with it, and they're probably what? Semi good at it.

Then if they focus on teaching math, then they should be able to do it better. Anyone departmentalized here all down through elementary school? What grade level? You go to third grade. That's pretty much where I've seen it. I've only been in one school that went down to the second grade.

You get into issues with large schools. If you have like five or six teachers at a grade level, seven or eight, how are you going to manage that? But I think it's a discussion point that should be brought up, because elementary teachers are having to teach everything.

And when you try to teach everything, you end up, sometimes, and besides teaching everything, what's your primary focus at the elementary level? Reading. And then math is whatever, you know, gets dispersed among science, social studies, and whatever, so I think it warrants a discussion. Yes?

WOMAN: As a math support teacher . . .

DR. RICCOMINI: So I'm assuming that means you're a special ed teacher. Is that what that means?

WOMAN: Title I.

DR. RICCOMINI: Okay.

WOMAN: We are often faced with making the decision . . . classroom teachers, and these are, this is one of those situations where, you know, Tier 1, and they're all in there and whatever . . . if we have children who are not at that level . . . but the teachers are moving on. We stay back here and try to move to automaticity, but do we try to give them more examples . . . classroom?

DR. RICCOMINI: Excellent question. Did everyone hear that? The idea is that Tier 1 teacher, she's a math support teacher, so they're pulling kids out providing them additional support in math. So she's working with a lot of kids that are not necessarily at the automaticity level, and the Tier 1 teacher is moving on. And her question is what, as a math support teacher, what should they focus on, automaticity or moving on? Right? Did I summarize that?

The answer to that is twofold. First, there needs to be automaticity in Tier 1. As little as five minutes should be devoted to automaticity in Tier 1. Okay? If you're not doing it in Tier 1, that's a mistake. I don't understand why it's such a big issue in math. We teach automaticity, and, we teach it in reading. I guarantee you're teaching automaticity of reading.

You want kids to immediately know what a sight word is or the . . . list? You want kids to read fluently. You want kids to spell fluently. We're teaching automaticity. We do it in music. It's not good enough that kids can play the notes. They have to what? Keep up with everybody else. All right.

We're teaching automaticity across a lot of content areas in the core. So the first question is it should be happening, to some extent, in the core. The second piece, the math support model, which I actually think can be very beneficial, that math support, whatever amount of time you should have, you should have it split like 60%/40%, 30%/70% where 60% is devoted to re-teaching, in other words, going back and re-teaching things that they've missed.

It could be a concept. It could be automaticity. Whatever. And then the other percentage of the class is set at extending what the kids are doing in the Tier 1. You can't just focus on what they don't know, because the Tier 1 teacher is moving forward. So you've got to sort of have a balance in place.

But the automaticity is something that can be done in as little as four to five minutes. It's not something that should be any longer than ten minutes. It needs to happen somewhere. It should be in Tier 1 to some of that time, but math support is also another place to address it. So you can address the, specific to automaticity, you can address automaticity in five- to seven-minute bursts. Now how long do you have for the math support?

WOMAN: Usually about 40 to 50 minutes . . .

DR. RICCOMINI: Oh? Every day?

WOMAN: Two to three times a week.

DR. RICCOMINI: Oh, well, that's, I mean, that's good. Two to three days is good. So what you want to think about is, okay, I should be spending 5 to 10 minutes of this 30 to 40 minutes on automaticity. And then the other time, I should be either re-teaching or extending, giving kids more opportunities for what they're having in class or even pre-teaching. Any questions at this point?

So in Pennsylvania, you have the tier just like you have in every other state. Some states have four tiers. Some states have two triangles stacked on top of each other, because now we're talking about gifted kids in the RtI Model, and it's a reverse triangle. You know, I don't know.

Bottom line is this is all destined to end up as a bad research study if we don't change our instruction, and that's the key. All right. Remember when you tried to make a little volcano science kit thing with your kids, and it made a total mess? That's where we're heading if we don't address it. And it's different, my opinion, it is different in math.

We have got Core Reading Programs that are well designed. In math is where our Core Programs have not evolved instructionally. So when you look at this, there's sort of ten pieces that I generally revolve around. Obviously, in today's two-hour session, we're not going to get into ten. I'm going to pick these two, three areas, explicit instruction.

Everything that I talk about is related to it explicit instruction. And I'm going to sort of move through these, and then at the end, I'm going to talk about two very specific strategies that are just very different approaches to how we've been teaching in math, and we have to start examining that and evolve.

Basic facts. So this lends right into your question. I gave her that question and told her to ask it at 3:06 just to lead it to this. Basic facts. This is one piece of math, and sort of think of it as the alphabetic principle in reading. There's a progression. In order to have that skill developed, you have to know that every letter has a sound.

Is that reading? No. Then you have, the next step is you need to recognize that words are made up of letters that have sounds, and if they're read together or blended, that produces a what? Word. Is that reading? No. Reading is when you do those two skills fluently in connected text that allows you to what? Comprehend.

I really look at when kids solve a math problem or apply it or whatever, I look at that as comprehension, and I think math teachers need to expand their, you know, is the answer correct versus did they comprehend what they did. So with basic facts, you sort of have this similar progression.

You have to develop the concept of the operations. In other words, what is addition, subtraction, multiplication, division? This is where teachers, for multiplication, they do all these wonderful things with the rays and sets of objects and make the connection to repeated addition, and they can develop the concept.

Then you move into where you're getting into sort of the relationship piece where they're doing the fact families, as I said earlier, and they're developing strategies. Near neighbors, count on, you know, those types of things, sort of anchor facts. If you know what the anchor fact is, then you can use that to figure out the next one or the nine-finger rule or singing songs or whatever it is. All right.

Where we generally then jump to is we've done all that, so kids should automatically know their facts, and that's where kids are having problems. So if you're in a math support role, you want to try to get kids to automaticity. Now the key is automaticity means that you just know the fact.

So if I, like a good example of that is to blank out your minds, blank them out. Everybody's like I've got this one down pat. Blank it out and don't answer this. And if I say five times four, even though I said don't answer it, and you were trying not to answer it, you all what? Now where's my kindergarten? Twenty. Have you got 20 there? I mean, I'm just kidding. I'm teasing. I know, I know. I'm just kidding.

The idea here is why is that important, not from a math standpoint, but from an instructional cognitive standpoint? You used no working memory to answer it. Now no one, I didn't see anyone doing a little jingle there about five times four or singing a song. It's automatic. So all of those things I'm talking about, the concept, the relationship, the strategies, the songs, the jingles, those are all fine and dandy.

But at some point, we need to get them to where they're automatic. And, folks, the only way you get kids, the only way you get automatic on anything is you do what? You have focused, strategic practice. Now focused and strategic means you're not practicing all of them for ten minutes.

Think of your math support kids that you have that are not automatic. So they're either getting it wrong, or they have a strategy, or whatever it might be. What grade level are you doing math support? You're sixth grade.

WOMAN: Well, for math two through six.

DR. RICCOMINI: Okay. So think of your third, fourth, fifth grades and multiplication. Is it that they're not automatic on every single fact? They know their tens, usually their fives, zeros, ones, twos. So now you have your math support, and you're trying to help. First off, so that tells you they do not need to spend time on worksheets or practice that includes all of those facts that you say they already are automatic on.

So your first thing is you're going to chunk. I've already used that term. So you literally will pick three or four facts that they don't know, and you will focus almost exclusively on those facts in your little three- to five-minute activity, which can be done whole group, independent, partner practice.

I'm partial to flashcards, but the idea is that those three that you picked is your chunk. They're getting multiple repetition on those ones, until they have them automatic. Now when I taught, I also taught high school, and I was a learning support high school teacher as well as a regular math high school teacher.

And one of the things my learning support kids came in, the classic I hate math. I hate you, because you're the math teacher. Ticked off. They put letters in number problems, okay, and they didn't know their facts. I mean, classic learning support kids. They couldn't memorize their facts.

So as I got to know my students, this was my second year of teaching, as I got to know my students, what I began to learn was, yeah, they couldn't remember 390 math facts, but they could recite to me 100 songs from 10 different of their favorite singers. So the question is, is it that they don't have the memory capacity, or how we've been going about it?

And it's generally how we've been going about it. How did they memorize those songs? Do you think they listened to every single one of them in order from start to finish to memorize it? They listen to one song what? Over and over. They stop it, and they go back. They find the lyrics, and they listen to it. They're essentially doing what we need to do with our basic facts.

So things that are like pet peeves of mine, when a teacher says, well, they're learning all of their threes, and then they're going to learn their fours, fives, and that's all they practice, that's more of a relationship-building activity, like copy all your threes. Watch your kids do that. And you know what they do?

Three, three, three, three, times, times, times, times, times, one, two, three, four, five, six. It's a relationship, copying in the multiplication table. All right. They come up with some unique relationship versus the automaticity. So to promote the automaticity, find out the ones they don't know, chunk it into three or four, and give them multiple opportunities on those specific facts.

And when you're doing this activity, there's two types of errors. There's a hesitation. In other words, you give them five times seven, and they go five times seven. They start counting. That's an error. Could they have gotten the right answer? Yes, but we're past that.

And then if they give you the wrong answer, now, for your middle school and high school teachers out there, you need to get kids to almost automaticity or fluency on integers, positive and negative types of things, as well as recognizing various things that you're teaching more automatic.

So you've chunked it. You're giving them multiple repetition. They make a mistake. They're immediately corrected, and you do it systematically. That's how you foster automaticity. Most Core Programs don't do that, because they're trying to teach so much at once that they, maybe on one day, they cover all the multiplication facts.

But it's that type of strategic chunking that will get kids to where we want, and I think there are some programs. Where is it? Here it is. These are the steps that I just went over. So you chunk them into three or four that they don't know. They get intensive practice. You continually review the ones that you've just focused on, and you have some type of monitor in place, and you make it fun. Make it a game.

Now it has ten minutes up here. This should be no longer than ten minutes. And in all honesty, you should get it down to five, because this is not math. This is about an instructional tool to facilitate learning later on, and you have to develop the concepts prior to automaticity.

I can take kindergarten kids and teach them what five times seven is, and they can probably remember it just like they remember *Brown Bear, Brown Bear*, *The Hungry Caterpillar,* whatever. But that's not going to do them any good, because they have no conceptual basis for that operation. That'd be like teaching kids to just memorize vocabulary words without teaching them what they meant. So there's a progression here. Questions?

There are programs out there, peer-mediated. There's a, here's an example, Mastering Math Facts. You don't need programs to do this. Sometimes when a program is initiated, it makes it more regular. In other words, it happens versus leave it up to the teachers, because sometimes there's lots of things happening.

But the idea here is fluency is good. But if you have kids stuck with strategies, as they get older, those strategies become inefficient and will tax working memory and cause kids not to learn as efficiently would be a good term there. And the same principle applies to integers, trig functions. Things you want kids to become automatic with can facilitate the higher order problem solving application thing.

Now the key is any automaticity is done after the concept has been developed, and it's a progression. Questions on the basic facts? The IES Guide actually recommends that teachers are spending time developing not just basic fact automaticity but computational fluency on two-digit by two-digit, on fractions.

So once you develop the concept, once they know how to apply it, that they need to become more fluent with those pieces. The next big phase, this really is the instructional scaffolding, oh, yes, I'm sorry. Go ahead.

WOMAN: I really struggle with this, because I work at a rehab center . . . and the kids . . . court system. They bring them up there. I've been seeing children 17, 18 years old, and a lot of them still have no clue of their multiplication tables, or some of them not even their arithmetic facts. And it's like, and I'm supposed to be teaching Geometry and Algebra 2. That's the subjects that's written on their report cards.

And it's like do I try and take time to teach that stuff or try to give them the concept information so that they can actually, if somebody says what'd you learn in Geometry class, I'd hate to have to say I do my multiplication tables.

DR. RICCOMINI: Yes and yes. You need to spend time on the automaticity. Now, at some point at the high school level, we have to introduce the idea of calculators, and how those calculators are used and applied. But this, the mistake we make is automaticity is a small part of instruction, three, four, five minutes.

Now once you get past fifth grade, you need to focus on multiplication, because multiplication is so important with fractions and geometry and measurement types of things. So at some point at the high school level, you have to introduce kids how to use calculators and so forth.

But recognize if you give kids calculators that don't have basic facts down well, you're going to increase their errors, because they're not going to know on the calculator whether that answer is right or wrong. When all of us use a calculator, at some point, we get an answer, especially when we're doing our taxes, and we're like, what? The reason we know that is because we've done the what?

The basic estimation computation in our head. So my answer to you is you need to teach the geometry pieces, but I think you can work in, in five to seven minutes, the multiplication facts. That's my answer to that. And then you need to use calculators at the high school level, obviously.

My calculator, back to my second year, third year of teaching with this learning support class, so I gave my kids, calculators, and I'm a firm believer in calculators, okay, especially graphic calculators. Although you are starting, I am starting to hear that graphing calculators are being banned in college calculus classes in engineering programs, because the professors are saying, yeah, they can do it with that.

Or in other words, they know what numbers to put in, and the calculator will give them the answer. Those graphing calculators are mini computers, basically, and they have no concept of what it is they're doing. But, anyway, so I gave my kids the calculator, and a boy raised his hand, and he's got the answer. And on his paper, he wrote e-r-r-o-r in block letters just like the calculator, because that's what was on the calculator.

Therefore, that had to be the answer. So just recognize it's a tool. All right. If I get Tiger Woods golf, well, not, Phil Mickelson's golf clubs, okay, the best in the world, they cost $20,000 whatever, and I use them, am I going to then be a PGA professional golfer? No. It's a tool. So just keep that in mind. You have to teach kids how to use calculators.

But back to your question. I think there can be a time and a place for both, but you have to focus on the geometry for the majority of your class. Any other questions before I move on? Scaffolding. This is where teachers need to focus, and scaffolding is anything you do to support learning.

Now the best analogy is when you teach a kid to ride a bicycle. How many of you have ever taught your own flesh and blood to ride a bicycle? Raise your hand.

Raise it up. Now keep them up. Keep them up high. Everyone who does not have their hand up, look around at all your colleagues that have their hands up and recognize this. They're liars, coldblooded liars. Okay?

The kindergarten teacher is going uh-uh. What do I mean by that? When you get your kid on that bicycle, they look at you in their most trusting face, voice, eyes, and they say to you don't let go. And every one of you that had your hands up said, oh, honey, I won't knowing full well in 30 seconds, you're letting them go. Okay?

Then as they start riding away with you running beside them, what do you slowly do, just let go? No. You slowly loosen your grip, and what happens to your child? And the lying starts again, because now they're screaming at you not to let go. Some of us are letting go as we're telling our kids I'm not going to let go.

And some of us, the real sneaky ones, will let go and run beside pretending that they're still holding on, and then the kid rides away just fine. And then what happens as they're riding away just fine? And then they crash. That is scaffolding to a tee, and this is the art of teaching.

Some teaching is very scientific. This is the art. How much scaffolding? When do I let go? How do I fade it away? Special ed teachers, we generally do too much scaffolding, okay, because we are there. We know the kids are struggling. We know they're behind. We are trying to do everything we can for them to be what? Successful.

And then, generally, what happens is we never fade ourselves away, and the kid leaves your classroom and what? Can't do it. General ed math teachers, we generally don't do enough, or we give one scaffold for everyone. Now there's 30 kids in your class, 20, I mean, there's a lot reasons why this is.

The idea though is this is really going to help facilitate learning is this scaffolding piece. Now there's three types of scaffolding that are out there, content, task, and material. I'm only going to get into content today. My sort of experience of observing teachers is they, we are doing a relatively good job with task and material.

Task is like, you know, you have checklists the kids have to work through, or you teach them some mnemonic for problem solving or steps, materials. You're providing them something to help them work through a problem, a chart, a figure, whatever it might be.

But content scaffolding is where I think we need to try to focus some of our efforts in improving, and I'm going to show you one way to do content scaffolding with problem solving as well as a guided think aloud. Now we're kind of going to get crunched for time, but I'm going to move through this rather fluently. I'm assuming you can keep up with me. If not, you'll go to support class after this. Okay?

Content scaffolding involves trying to reduce things, I use the term things, because when you start saying procedures or steps, then people get all bent out of shape. Try to reduce the things that distract kids from what it is you're trying to teach. And there's a lot of things that this can take place.

But with problem solving, how is problem solving generally presented in math class? In a word problem, because in the real world, everything is in a word problem. Right? I'm being sarcastic. I realize it's late in the day. So in a word problem, just real quick in your table, take 30 seconds. What is it that's most distracting to kids about a word problem? Go ahead. A minute. What have you got out there? What's most distracting to the kids?

The words. Right. I knew that. If you can't read, obviously, the words, but I mean more. What else? The context. That's right. If it has a kid's name in it, then everyone's making fun of the kid. Right? Okay. I love this. Put names in word problems, and they'll be able to solve it.

I've got some golf holes named after me, not because I'm good at it, but because I'm bad. It doesn't seem to help. What else is distracting, can be distracting? Irrelevant information is one of the most difficult things for kids with learning disabilities to determine, and word problems are terrible at throwing in irrelevant information, but I still don't think that's the most cognitively distracting thing.

What, okay, you're getting closer. When kids look at word problem, what do they want to get? The answer. Right. So you put a word problem up, and you try to get into the thought process, and the kid in the back of the room or half of the kid goes 25. And you look at him, and he goes 23, 21. Did you add? Yeah. You did? No. I subtracted, multiplied, divide.

It's just, that's problem solving to them. Get the answer. Because they have learned that if they get an answer, then they're done. Right? And if they wait long enough, we will come along and what? Tell them the right answer. So cognitively, sometimes in word problems, the actual getting the answer interferes with problem solving.

Getting the answer really isn't problem solving. Problem solving is taking a math problem, figuring out the context, what it's asking, and then representing it in a number sentence/expression. So with content scaffolding, your main idea here is you're trying to remove things that are distracting.

So this is an eighth grade problem here. Robert planted an oak tree, an oak seedling. It grew 10 inches the first year. Every year after, it grew an inch and one-quarter. How tall was the oak tree after nine years? Well, half of your class has already shut it down because of what? The fraction.

So now you can't, you've already lost your class, because they see a fraction, and they don't want to do it. So now whatever follows has lost half the kids. The other half is looking at this and starting now to do what? Either yell out answers or making fun of Robert for planting an oak tree. All right.

So the problem below it is rewritten with content scaffolding in mind. So I took out the name. I took out the fraction. But most importantly, what did I do? I took out the question and put in the what? Answer. So now I've taken that off the table. Now some of you are giving me this strange look. Whoa, whoa, whoa, whoa. You put the answer in. That's not how we do math.

This, but this can be a strategy to help you teach math. And the idea here is we are going to start at a point and progress the child to where we want them in the end. Often, we start with the most sophisticated problem, the Robert, the fraction, and the question, and that's where we want the kids to start.

By following content scaffolding, we're going to start them on a problem that now, because the answer's in there, and they're not scared off of the fraction, they will at least, hopefully, what? Engage. All right. So now if you have your supplemental handout, it's in there, if not, you don't need it.

Now I'm going to take you through this progression of how this might look in your classroom, and the key here is I'm also going to show you how to do a guided think aloud. So, so far, up to this point, I've talked about chunking in considering working memory. I've talked about automaticity on basic facts, which also involves chunking. And now we're moving into the scaffolding piece, and one scaffold is to put the answer in the problem, and that can be done with anything.

What we're recognizing is giving kids access to the answer can facilitate learning versus always trying to work towards an answer. So if we look at this problem, I want everyone to put their pencils down and just listen to what I'm going to say right now. Okay? And I know you're taking notes and that kind of thing, but that's another strategy.

If you're, especially at the middle school and high school, if you're having kids take notes, just recognize they're not hearing 80% to 90% of what you're saying, because they're using almost all of their working memory to do what? Write down. And they're never writing down what you're saying, they're simply writing down the numbers or the result of what you said.

So if I'm the teacher, the think aloud that I constant, that teachers are doing good job of and you want to continue are, this is going to go something like this. An oak seedling grew ten inches in the first year. Okay. So in the first year it grew ten inches. Every year after, it grew one inch. So after the first year, for every year, it grew one inch.

So it grew ten inches in the first year, so there's your initial growth. Then after that initial growth, it grew one inch every year. After 9 years, so of 9 total years of growing, the first year the tree grew 10 inches, so that leaves 8 years that it grew 1 inch each of those years, and at the end it was 18 inches tall.

So how much did it grow in the first year? Ten inches. How much did it grow each year after the first year? One inch. And it grew a total of nine years. The first year you just told me was ten inches, so that leaves how many years that it grew one inch each year? Eight. And in the end, it was 18 inches tall. Okay. So let's write our number sentence.

Now before we write our number sentence, we've got to talk about math here somehow. Now the word grew, so this tree is growing, what does that mean? It's getting what? Bigger. So in math, what operations generally give us a bigger or larger result? Addition and multiplication. So maybe we're going to add, maybe we're going to multiply.

Well, we're going to do the eighth grade problem as if you don't know how to do multiplication, so this would be what an eighth grade problem can be done with first-graders. So let's write our number sentence. So how much did it grow in the first year? Ten inches. So let's write our ten. Write your ten down. That's how much it grew in the first year. Play along with me. Write your ten.

Now we decided we're going to add here. Right? You don't know multiplication yet. We're going to add. So we're going to add, so we know how much it grew in the first year. Now we have to know how, we have to add how much it grew after that first year. So after that first year, it had eight years to grow, and in each of those years, how much did it grow? One.

So we have to add one how many times? Eight times. You see the obvious connection to multiplication there, so let's add one eight times. So plus your one eight times. So double-check what you have written out. What's your initial growth? Ten inches. How many ones did we add? Why did we add eight ones? Because it's, it grew eight years after the first year one inch.

And then how tall is it in the end? What does this equal? Eighteen. Now for those of you that have kids that can't do computation, by putting the answer into the problem, have you had to do any computation? No. You've scaffolded it off the table. All right.

So let's check our number sentence. Do we have ten in how much it grew in the first year? Yes. And then do we add eight ones, because it grew one inch eight years? And in the end, does that equal 18? Okay. Now what I want you to do is turn to a partner at your table, and both of you take an opportunity to re-explain our number sentence. Go ahead. Play along with me.

I know I'm not giving you, now you're going to give kids more chance here, but that right there is also very different, a very different approach than how most math teachers teach math. In the terms of we do the think aloud, which is what I just did. I've seen teachers do that. I'm convinced everybody in here who teaches does something like that.

But the difference is what we generally do as math teachers, is after we get done doing this problem, we go on to what? A totally different problem. And we expect the kids to what? Transfer or generalize. So what I just did, which it doesn't take a whole lot of time on our part, is I gave the kids a guided think aloud.

In other words, how many times did I model that think aloud with just me? Two to three times. Then we had a discussion. Right? I said, well, how much did it grow in the first year? Why did it do this, etc., etc., etc.? Which is what teachers are generally doing.

But then I gave you an opportunity to rethink what I just modeled, and that is a key piece. It does two things. It's chunking it, as well as it's alleviating working memory, because they're essentially redoing what I, what they've just heard. Now a lot of times, kids, you do that. You go to a totally different problem.

The next problem is about Suzy going to the mall and getting a discount on shoes or something. Now the context is what? Distracting. Now they've got to relearn this whole context, and it takes away from the process. Now this is a progression. Now, by the way, this would be sort of three ways you would do this.

If you don't know multiplication, that's more of the first way. The middle way is, probably when kids know multiplication, the middle way is probably most connected to the language. The third way is more of the algebraic representation, which is what you're going to do at more of the upper grade levels. Now here's what's interesting.

The language is essentially the same at all levels, and that's why this is so key in mathematics. You had to determine how much it grew initially at each of the problems. Then you had to determine how much it grew after the first year. So I said things like, well, it grew a total of, look at the bottom problem, well, it grew one inch after the first year. So there's my one in parenthesis.

It grew a total of nine years, but in the first year, it grew ten. So that's that nine minus one. The language is the same, and that's why elementary teachers, if you haven't heard this, what you're doing from a language standpoint is setting up algebra. It really is.

So now you've got advanced kids in your classroom. They may automatically default to something. If they're bored, then have them represent this problem three different ways and extend those kids. Now here's the next sort of step in this problem solving progression.

So we've explained this. I've modeled this. There's lots of extensions. For younger kids, maybe you don't even start with numbers. They are concretely modeling it, so you use base ten blocks to model the first year, what happens the second, etc., etc. There's pictures, all different extensions that you could do here.

The next step in this progression is this. I want to get, I want to remove myself a little bit, make it more on the responsibility of the student, so I give them essentially the same problem with different what? Different numbers. So now this is guided problem solving. So, hopefully, now since we've talked about it initially, the kids will have an idea.

Now I can make this another more modeling or more demonstrated or more guided. For this purpose, go ahead and write your number sentence, and you can do it, if you're in elementary, just do it with addition. If you're at middle, do it with multiplication. If you're high school, do it algebraically, but write your number sentence for this.

Now as you're doing this progression, this is, again, very different than the way we've been teaching math, which is to go from problem to problem to problem to problem. So this is a careful sequence. You're trying to scaffold some things off the table like computation, trying to get the answer, trying to get the fraction. But as you move forward with this progression, you will eventually want to bring that kid back to that most sophisticated problem that has the fraction and so forth in it.

But within this, this is also a good place to have kids rewrite problems with variables. Okay? So now we've explained it. Now how can we represent this with variables? And we're not going to do this now, but we're representing this with variables, as soon as you put X, Y, Z or any letter into an expression or an equation, it has to have a what with it? A tag or a definition.

And in our variables here, we've already discussed the definitions, initial growth, subsequent growth, total growth. So this is sort of getting at the language of math and how it is represented. Now, so as we've gone through this progression, you'll eventually want to bring the students to a word problem that has a what in it now? A question.

So you've scaffolded it. Now keep in mind, there is one disadvantage to this approach, and that's why you don't want to do this every day. The disadvantage to this approach is although you're teaching in depth, you're really exploring, you're going to get through fewer different problems. Does that make sense?

I mean, we're focused on this growing, which is fine, because we've been throwing at kids all different problems forever. So this is a way to get a little more focused. When you're deciding what to do here, this is, if you're doing support, maybe you pick a problem that you know the kids are going to see in class. If you're a Tier 1 teacher, maybe you spend every once in awhile doing this progression, this scaffolding.

But putting the answers in problems is something we need to do more of all the time. This progression is a little bit more involved. So you take them to where they have the question. The other thing I want to encourage math teachers to do is instead of going to different problems is to rewrite the same problem but ask the question differently.

So in this case, we're asking total growth. The problem could be asking, well, a tree grew a bunch in the first year, and every year after it grew two meters. After 7 years, the oak tree was 16 meters tall. How much did it grow in the what, the first year? So explore the problems versus going to all different ones in some instances.

Now, eventually, you want to get the kids back to where they have the what? The more extraneous stuff. Now, hopefully, the discussion and how you've gotten to this point will put them in a better position to what? Handle this type of thing. I always think in terms of progression. We've got to get them to the more sophisticated type of problem that's got all these various things in it.

Now if you're really strategic in terms of how you set this lesson up, in my opener or warm up, which most math teachers do, five to seven minutes, I would've made sure that in that warm up to have a what? A problem that had a fraction in it. So then the kids see it there, so when they get to the problem solving, they're not completely freaked out by it.

But this is what we have to do more of in Tiers 1 and 2 in terms of trying to facilitate learning. We can keep giving kids this problem from the start, and we will keep kids yelling out the answers, guessing, shutting down, and not engaging. Now material scaffolding, I think teachers are doing a good job with this.

This is where you have concept maps, graphic organizers, those types of things that are sort of, you know, getting at the process. And I think teachers do a pretty good job in that area. The task scaffolding is where students really struggle. Now in your materials, we're not going to do this now, but I gave you an example in the supplemental handout on how you might scaffold this question.

Now scaffolding is about providing the support based on kids. And if you look at that, if you take some time to look at that example, one of the scaffolds is giving the kids the answers up front. How many of you, when you were taking math, hoped with everything that the teacher assigned what type of problems, odd or even? Odd. Because if you couldn't figure it out, you at least had what? An answer that could maybe help you what? Work backwards.

All right. That facilitates learning. So bottom line with the scaffolding, we have to do more of it, especially for the kids that struggle. So you want to keep that in mind. I just gave you one example. The main piece of this example was I put the answer in, I chunked it, and I had you re-practice a think aloud that you just did. I mean, that's the main pieces in that scaffold, and that can be applied to basically any problem solving situation or upper level math.

Now note the instructional piece, or the explicit piece, I've already talked about it. That scaffolding was very explicit, but notice there was dialogue. Right? It wasn't me just lecturing. There was dialogue. Okay. So explicit means a lot of things. Now the last two things that I'm going to cover in five minutes, and then I'm going to give you five minutes to do the evaluation, and you get a special code or something that you have to write down.

If you don't want to do the evaluation, just leave it at your desk. I'll take care of that myself. But these last two strategies are absolutely imperative in Tier 2 but have widespread application in Tier 1 regardless of the Core Program. What I'm going to interleave plays right into what I just did, spaced learning over time.

What happens at the end of a unit or a chapter in math in your schools, in your classroom? What happens? You have a test. Right? What happens the day before that test? Everywhere I go, that's what happens. Now let's see who's honest. What's the purpose of that? First off, what are you reviewing? What you just taught.

Now here's the, let's see who's being honest here. What's the purpose of that review? To pass the test. Notice no one said, oh, to promote long term learning, to facilitate more proficiency in mathematics. It's to help the kids what? Pass the test. All right. This is a different purpose for reviewing.

What this research showed was related to long-term retention. In other words, helping kids remember things. You know, do our kids have issues with retention? Do some of our spouses have issues with retention, like I thought I told you to take the garbage out? Oh, I forgot.

We, retention is about remembering. Okay? Now some of our kids can't remember what you told them 30 seconds ago. But if you improve student's retention, by accident, what are you going to more than likely improve? What happens at the end of the year? The test. That's a long-term retention test.

So, but here's what's different between how we're reviewing it. What they found was you will promote retention, in other words, improve retention, if you wait four to six weeks to review something after it was taught.

WOMAN: . . .

DR. RICCOMINI: The way we currently review is we teach for two weeks, and then we review what we just taught immediately after we taught it for the test. What this research shows was you'll get a better bang for your buck in terms of long term learning if you wait four to six weeks after you taught it.

So in the materials, I have this chart in place, so if you're going to enact this sort of policy, which, by the way, you need to do this. Kids in math, math very fundamental and foundational, and if kids are missing certain pieces or forget, then guess what, it's going to be a problem.

So you basically, the way you enact this is you chunk out your year in six-week intervals or four-week intervals, then you fill out column two there, which is, okay, what were the big ideas that were covered? This is more than listing a standard. This is getting into depth. What were the big ideas?

Then the third column is, okay, use teacher experience, data, benchmarks, any assessment. Of these areas, what are most problematic? And prioritize. I recognize that for some kids everything is problematic, okay, but you can't re-teach everything. So prioritize. Look at your end of year test. What areas are emphasized on those tests?

Most, and I'm not sure about the Keystone, but usually they say number and operations has a percentage, or x number questions or algebra functions, or whatever it is. Identify those, and then as a grade level, everybody at fifth grade, sixth grade agrees that four weeks after this was taught, we are going to revisit it instructionally.

Now this doesn't mean you give kids a worksheet or put problems on the board, and they have them do it, and then you go over it. This means you start off by saying, remember when we did this? And your kids are going to say what? No. And then we're going to get what? Mad or frustrated. But, remember, why did we pick that particular thing to review? Because you're predicting they're not going to remember it.

And you revisit it in a five-, ten-minute remember when we did this? This is why we did it. This is the standard it's connected to. This is how you do it. Let's do one together, and that's it. This is not re-teaching the whole thing. This is revisiting it and reawakening it. Critical in math.

So that's in there. Critical that this is done systematically across the course of the year. Right now, the way we prep kids for the end of year tests is what? Three weeks before the end of year test, what do we do? Mass cram, practice. This is done from day one. Now the last strategy is this interleave, and this goes right along with giving the kids the answer.

What this research, interleave means to alternate every other one, like shuffling a deck of cards. What this research did, and this came out of an IES Practice Guide by Pashler. If you get on the Center for Instruction, and you look for the one that says Organizing Instruction and Study Time, that's where this is, both of these are discussed. Interleave, what this research did is ingenious.

It took the way we've been doing homework forever, which has not changed. You give kids problems, and what do they have to do? Solve them start to finish. That's how we've been doing it forever, and the kids that do the homework tend to progress. And they compared that to homework given in this fashion, where every other problem was solved.

So this group got ten practice problems. This group only had five practice problems. And the kids were taught to study the solution, which will help you then solve the next problem. This group, who had half as many actual practice problems, outperformed the other group.

And what we're recognizing, and this was done about ten years of research from sort of cognitive psychologists, was by giving kids the solution, that's reducing the taxing of working memory, because they're not having to compute. They're able to focus on the what? The process.

So this has a lot of implications. Obviously, homework. But anytime you give kids problems to solve, consider giving them one solved first, then they study it. To me, this is how every one of you should change how you do your openers. Now I've not been in your classrooms, but I'd be willing to bet that 95% of you, except maybe for kindergarten and first-grader, open up your math class by having two or three problems on the board.

The kids come in. They sit down. They are supposed to solve those problems either individually or with a group. You give them five to seven minutes to do that. And then what happens after that? Then we go over it. Okay. Now that's a common math occurrence. This is one way that you can make it more instructional.

Instead of coming in and having three problems that they have to solve, the first problem is what? Solved. They are taught to study it and use that to solve the second problem. We need to do more of this as this research was specifically done with seventh, eight, and ninth grade students. If you're a high school teacher in here, and you don't take advantage of this type of strategy, I can't help you. Yes?

WOMAN: . . . and they wouldn't even look at those problems.

DR. RICCOMINI: And I would say you're absolutely right. And you didn't hear subtly what I was saying, was you have to teach the kids how to study the problems in class. All right. Heck, if you gave me ten problems and half of them were solved, I wouldn't do them. What, and I started to think about this. This makes perfect sense.

How did I study for calculus when I was in school? I went back into my notes, and I found problems that were what? And I bet all of us did this. And I studied that solution, and then what did I do? Covered it up, and tried to what? Re-solve it. This is a way to facilitate learning, but you have to teach the kids how to study the problems.

When teachers they say, well, yeah, but conscientious kids look at it, the other ones don't. So you sort of have to figure a way to help the kids do this. If all you do is all the sudden give kids homework with this embedded in it, it's not going to help. But you need to make it an instructional tool.

Anytime in class that you give kids a problem to work together in a group to solve, bingo. Give them the problem solved, and have them discuss how it was solved. But this is a way to facilitate learning for kids who are having a lot of difficulties. Giving kids solutions facilitates learning, just like in that scaffolding piece.

All right. I talked about each of these. So sort of, the summary here, we have to try to work smarter not harder, and we have to focus on our instruction. My big phrase, people are sick and tired of this, is instruction matters. If you don't believe what you do matters, I hate, I cringe when teachers say it doesn't matter what I do, he's not going to learn.

You've just laid the groundwork for everybody who is against teachers. You're essentially saying it doesn't matter that I'm there, or you're there. It doesn't matter. So instruction matters. That is the main component in RtI where we need to focus in the area of mathematics. Questions? And I know no one is going to ask a question, because you'd be shunned by all your peers.

But if you have questions, feel free to e-mail me. I'll do my best to answer or point you in the right direction. But I wish you the best of luck. If anyone's driving home, drive carefully in this massive snowstorm that hit the Hershey area, and I wish you the best of luck, and I'm going to turn it over to, thank you.