

PRESENTER: So Steven Leinwand is a principal research analyst at American Institutes for Research, and has over 30 years of leadership positions in mathematics education. He currently serves as a mathematics expert on a wide range of AIR products -- projects, I'm sorry, that evaluate programs, develop assessments, and provide technical assistance.

Mr. Leinwand's work at AIR has included developing specifications and an algebraic reasoning item core for the NCES high school longitudinal study, serving as implementation task leader for the IES mathematics professional development study. He co-authored *What the United States Can Learn from Singapore's World Class Mathematics System*, and *What Singapore Can Learn from the United States*. Co-authoring a comparison of the 2007 grade three assessments administered in Hong Kong and in Massachusetts.

Before joining AIR in 2002, he spent 22 years as a mathematics consultant with the Connecticut Department of Education. Mr. Leinwand has also served on the NCTM board of directors, and has been president of the National Council of Supervisors of Mathematics. He is also an author of several mathematics textbooks, including *Sensible Mathematics: A Guide for School Readers*, and *Accessible Mathematics: Ten Instructional Shifts that Raise Student Achievement*.

But before I bring Steven up, I just want to go through a couple things with you, just a few group norms. We just want to ask you to turn your phones down, please. Remember, we don't have wi-fi access in this room. Since PaTTAN has gone green, you know, all our handouts are on the website. You are being recorded today, so we're going to ask that you keep your side conversations, you know, to a minimum. We have a publication upstairs. Please visit the publication table to see our publications. We do have a [inaudible] study poster session, mathematics. If you haven't gotten by there, please go by there and get that, or see it rather and get some of those handouts they're giving out.

I know you've seen the vendors. I know you know where the bookstore is. So our announcement -- our refreshment break today is a morning break at 10:30 and the afternoon break is at 2:00. So without further ado, I'd like to bring up Mr. Steven Leinwand.

STEVEN LEINWAND: Good morning. So thanks. What Jackie didn't say is that the bottom line -- can we turn the volume down just a tad? I think, yes? Yeah, good. What Jackie didn't say is that all that really -- that's all right. They're just having to do their job. Is that basically I'm just a troublemaker and a math geek. The math geek in me, I mean, you know what's so amazing? I mean, at this very moment, the real-time, that is the electronic time, is 8:34, which is totally aligned with my watch, which is the, you know,

anti, old geek time. And it's like it never happens. And so, I mean, the geek in me sort of starts the day off saying, what a wonderful day. My watch just happens to be aligned with the real time. How often does that happen in your life?

And number two, ignore all that stuff about cell phones. Ladies and gentlemen, take out your cell phone. Take out your iPod. Take out your Blackberry. I don't care, okay? The fact of the matter is it is a brave new world. You aren't going to sit there and put your cell phone away any more than the kids are. And if we're going to continue to play -- yeah, you laugh. You laugh. We come to a conference and it's like, screw you, I got my computer. I don't like that there's no wireless in this room. I'm going to take notes. That's the way I operate. You think that I'm going to actually go for two hours in this room and not be in touch with the real world and get text messages from my kids? Why are we different from the kids?

And I use that to remind you that we play stupid power games at the expense of kids. And it is a brave new world. We are wasting our time if we're going to talk about making math work for all kids and thinking that we can do it the same, old way. Today is about a desperate need for some mindset shifts. Today is about recognizing that these common core state standards are not going to happen because we publish them. They ain't going to happen because we pontificate about them. And they are not going to happen because the Pennsylvania Department of Education blesses them.

And even now, there is this ridiculous rumor that Pennsylvania is going to back off. Trust me, it's not going to happen, all right? And as soon as you see what the other tests look like, Pennsylvania is not going to maintain its testing program. Much as you may want it, it ain't going to happen because it's going to be cheaper and better, and you guys will be left behind. So now you know, fasten your seatbelts.

What a great time. What a great time to be convening and talking about mathematics. My god, we've got these common core state standards that are not the primary topic today, but they infuse everything that we're talking about, right? We actually have in this world quality K-8 materials. The fact of the matter is the best materials are the hardest materials to teach from. The best materials are the most controversial materials. But if you've got things like the investigation's program and Everyday Math, if you're using Trailblazers, if you're using some of the reform programs, if you're beginning to use correctly even Pearson's Envision program, where you don't skip all of the critical activities that are in the [inaudible], you are making teachers lives harder, but you are enhancing the chances of kids learning mathematics.

We didn't have that when, 10 years ago, everything was the same sugarcoated [inaudible] that guaranteed that half the kids got screwed. You know that and look at how far we've come. We have -- I mean, you have to pause. I mean, if you're a math geek or if you sort of care about math, you need to understand that this race to the top thing was a game changer, that for the first time in the history of Washington D.C., math came before reading language arts, that the tiebreaker on race to the top was math, which is just mindboggling. I mean, you know what, we have a president, whether you love him or hate him, he believes in science. He believes in data. And you have to at least honor, whether you are blue or red or up or down or liberal or conservative, at least somebody is saying, let's look at the data. Let's look at science. Let's worry about research. And let's cut to the chase.

I'm not going to spend any time on this, but I've got good news for you. It is clearly the beginning of the end of the mass killer of the math curriculum, and that is this horrible thing called algebra two. And so that's a whole other talk. But if you read the common core state standards and you really see what's going on and you compare that to what is happening back in your schools and your school districts at this very moment in algebra two, where kids brains are being put into vice grips, where they are learning nothing that has anything to do with the real world, that's the reality.

And finally, the best news of all and one of the major topics today, is that we ought to celebrate the fact that after all these years of, oh, let's get this new program in; oh, let's ram new testing down kids' throats; oh, let's bring in this intervention; there finally is a deep-seated, broad understanding that the only thing that really makes any fundamental difference is when teachers close their classroom doors and what they do in terms of questioning and explanations and honoring kids' thinking and all those things. And so the best news of all is I come today and remind you that there is finally this understanding that it's instruction, stupid, and that it's instruction that makes all the difference. And we need to find ways to cultivate it and broaden it and break down the isolation that exists.

You know that the single greatest obstacle to school improvement is the isolation of the professional. Every one of you knows when you wander down the hall in any school, you walk by a classroom and go, oh my god, if only I could put my kids and my grandkids in that classroom. You see the energy, you see the time on task. You see the learning is just oozing out with the energy and the excitement.

And you walk two doors down and you sit there and see kids practicing obsolete skills on a worksheet. And ladies and gentlemen, those days of kids being screwed in once place two doors down from kids being honored and taught and learning in another are something we all have to deal with. And

so getting there is my goal, okay? As abstract random as I may be, I can become stylistically very concrete sequential. And so I come today reminding you that all these slides are sitting on the conference website, okay? Everything is there so you have access to it. And in fact, there are two additional handouts that are on there so that everything is available to you. Okay? But if I don't press this thing the wrong way, right?

So I have three of these in my bag. I mean, talk about geeks and nerds. So I'm in St. Louis at the TFA, Teach for America conference, two weeks ago on Saturday. And I'm with some -- one of the TFA people that I've been working with in Hazelwood. And so I had my computer and then they didn't let me use my computer, so I had to put it into this thing in the university classroom. Bottom line is I left my little thing in there, the clicker that I like, the one I'm comfortable with. So no problem, Jimmy put it in an envelope, sent it to me, and it comes, and the envelope is empty. So now I'm down to two, which means this is my second backup, right? And it's just not -- I'm not quite -- so I'll behave.

But there it is. You got time to read it. my job today is to engage you in thinking about. That's a good start. And then being willing to act on, being able to act on, these issues of more effective instruction, higher expectations, and building this critical culture of professionalism in every math department within every school, and amongst the faculty in every elementary school. That is, I've got some perspectives, some understandings, some strategies, all for providing effective leadership in K-12 mathematics.

My agenda couldn't be clearer. I'm going to set a context, part one. I'm going to look for instruction, part two. I'm going to look at our roles and the specific things we can do, part three. Interrupt anytime. I will not get through any of -- the chance of getting through all the slides is almost zero, but we will do everything that's important. Then you have all this stuff sitting on the website.

My process agenda, look at this! Not only do I have a content agenda, but like the common core state standards, right, there are content standards and mathematical practices. Like the NCTM standards, there are the content standards: algebra, geometry, number measure, and data. There are the process standards: problem solving, communication, et cetera, et cetera. My process standards are to inform, like good instruction. I got lots of stuff that I need you to wrestle with. But big deal unless I engage you, unless I get you excited, unless I get the brain cells going, just like in a good class. Engaging isn't enough unless I stimulate, unless I give you a reason to care. And finally, the best classes you ever saw have just the right amount of challenge. Not too much, but just enough to make it work.

And so if all that makes sense, you have a sense of my content agenda. Three parts, couldn't be any more concrete sequential than that. You have a sense of my process agenda: to model classroom instruction, to inform, to engage, to stimulate, and to challenge.

Go. Here is the future. Because the future exists right now in Hong Kong. Ladies and gentlemen, third grade Hong Kong math assessment. Look at this! Oh my god, I got container A and it's -- container A is filled completely with water. And all the water is poured into container C. Does container C get filled or not? No, no, no. Look at that. Total agreement, no. Then all the water is poured from C into B, and what happens to B? It overflows.

I am now on a computer. I am now in 2014/15. In fact, I am in the spring of 2014 -- no, in the spring of 2015. I am now doing Park and Smarter Balanced Assessment. It is all on computer. And I then ask kids to click and drag or to write A, B, C in those three boxes. I have the opportunity to give you two points if you get all three right. I have the opportunity to give you one point if you got one out of order. I have the opportunity to give you no points if you get it all screwed up. I have the opportunity to give kids tests in real fashion. Ladies and gentlemen, you have 30 seconds. A,B,C; A, C, D; B, C, A; B, A, C; C, A, B; or C, B, A. Shh.

You get slapped if you say it first. Tell the people around you what you think. C, A, D, CAB. C, A, B, CAB. It's a taxi cab. It's just like taxi. No, it's not. Yes, it is. Wait a second, couldn't be. Who thinks they know what it is? Wonderful. Who wanted to call it out? Oh, you wanted? Good. Sabra? Sabra. Sabra, would you please stand? No, you sit right down. Tell the class why it's C, A, B. Notice how it is not the answer. I'm not going to give Sabra one bit of kudos for the right answer. What I want to hear is the communication. I want to hear the argument. I want to hear the reason. Sabra, tell us why it's C, A, B.

SABRA: Well, I picked B first because obviously that was smallest.

STEVEN LEINWAND: Oh, why is B the smallest?

SABRA: Because it didn't hold all the water.

STEVEN LEINWAND: Oh, so the water that filled A overflowed here, so B obviously is smaller than A. And you know that it's smaller than C because C had all that water in it. So B goes over here. Brilliant. Well, then why is it A, C, or C, A?

SABRA: Well, and I picked C second because that was the biggest because it held the water and it had more space.

STEVEN LEINWAND: Who would like to supply an alternative argument? How would you do it, ma'am?

AUDIENCE MEMBER: I'm just thinking that A might not have been totally full.

STEVEN LEINWAND: Ah, A may not have been completely filled. Exactly right, right? Container A is filled completely with water. No problem, I don't expect us to read the problem anymore unless -- than I expect the kids to. Excuse me, what you just saw -- what you just saw was incredibly bad instruction unless we had a working relationship, okay? Early in the year, I just squelched that kid in the most obnoxious and stupid and supercilious and sarcastic fashion. And we see it all the time. I apologize for what I just did.

Okay, if we hadn't read it, then in fact there is no reason to believe that it is. And so, what I should have said is, oh neat, how about that, class? If it wasn't filled completely. That's what honors that. Then what happens? And then we honor that stuff. That is instruction that gives kids a reason to care. I don't need to remind you that by the time they turn 12, they have the thinnest skin. And we make them stand up naked at the classroom and wonder why they start to hate it if they get things wrong, particularly in a world where everything is about right/wrong.

And so what I do now is just give you some sense of that's thinking and reasoning. That's modeling the kinds of things that we're going to see on our tests. That is a very straightforward kind of problem. And so, gang, how do we get there? Your knowledge, my opening gambit. Look, let's just be clear. Okay, ma'am?

AUDIENCE MEMBER: Can I ask you a question before we move on?

STEVEN LEINWAND: Sure.

AUDIENCE MEMBER: [inaudible]. And the answer is three pieces. And on a national assessment or a state level assessment --

STEVEN LEINWAND: Thank you.

AUDIENCE MEMBER: They're expected to put in three answers and we get credit for one, two, or three parts of that answer. But you said that you are -- you're looking for a logical argument.

STEVEN LEINWAND: Good. Wonderful. So here's the deal, okay? There are two parts to all of these assessments. There is an online, computerized portion, right? And there is a -- what do you call it? Written, fill in your work -- what are you calling it? Open assessment. Constructed response tasks. Okay?

I mean, for example, I'm sitting here right now. Pennsylvania is sitting there in Park and Smarter Balance at this point. Is that right? You guys haven't decided.

Okay. I mean, I actually have a bunch of prototype Park items that I sat working on over dinner last night, okay? And you know what, ma'am? Four of them are just like this, machine scoreable with all that stuff, click and drag kinds of things that are instantaneously scoreable in a multiple -- in a construct response fashion. And then three of them are open-ended that would be given separately. And then the scores merge. So good point.

AUDIENCE MEMBER: So it would be a variety of --

STEVEN LEINWAND: Yes, it has to be a variety because how else do you measure problem solving ability and reasoning? You can't do that just with a multiple --

AUDIENCE MEMBER: [inaudible].

STEVEN LEINWAND: Yes, it will clearly be balanced, right? Yes, the answer is all of the designs. Right now, you can go and see samples -- they're not really prototypes, but sample items on both the Park and the Smarter Balance websites. And then we're screaming and yelling that, in fact, they've got to have a website to show people what these things look like in a machine world. Okay, it's coming. By this summer, there's no question that both of the consortia will have those websites up. Okay?

So context perspectives, gang. Here it is. I need to do this like a hole in the head, okay? Yesterday, I talked to 500 people in Kansas, sitting at my desk. Two weeks ago, I did my first after school seminar to 12 people in an elementary school in Carmel, Maine. I didn't even charge for it. It is now Cisco telepresence. I sit at my desk. It's all there. I see them; they see me. It is so much better than Skype, it isn't even close in those kinds of ways. Okay, I drove up last night from D.C. I don't drive anymore. I fly anything beyond, you know, two hours because I can't multiprocessing. I mean, I just am a nutcase about those kinds of things. And the weather was miserable and I can't stand -- what is that? Oh, good, thank you. No big deal. I mean, the first time it rings, I don't have a problem. The second time, I smile. The third time, it's like what the hell is that? It works.

This is important, gang, because you need to understand that it's like I have 1,001 things to do. I need to be here and drive in the traffic and put up with the rain like I need a heart attack. I just -- you know, why do I do it?

AUDIENCE MEMBER: You love us.

STEVEN LEINWAND: I do it because there's a limit to how much can be done technologically. And I do it because I think that we have been set up. I think that the fact of the matter is we've had an underperforming curriculum. We have had a curriculum that has screwed kids. We have created our need for remediation and for interventions more than we have solved that need. Come on, gang.

Do you honestly believe that there is any second grade teacher anywhere in Pennsylvania that believes that they can make subtraction with regrouping algorithm work for all second grade kids? Why is it that 50 years ago, that was a third grade skill and everyone says, oh, math really worked back then 50 years ago, when it really didn't, but. And now we ram it down the throats of second graders when, in fact, you know that you are poisoning kids?

And now we have a common core state standard that spends first grade dealing with sharing and separating and all those kinds of things, and using materials, and then uses all kinds of mental math and understanding of place value and development of facts in second grade without demanding the algorithm until third grade. That is a giant step forward. I do this because we need to understand that that's the change that is afoot.

We do that because if you still are doing subtraction with regrouping in second grade, you're screwing kids. If you're doing addition/subtraction or fractions with unlike denominators before kids even know what the hell a fraction is, before they can order them and before they know anything about equivalent fractions, which is all prerequisite skills in fourth grade, you are screwing kids. Common core state standards moved that different denominators to fifth grade. Division of fractions, sixth grade. That is a mind boggling, long overdue shift back to rationality.

So your knowledge, your experience, your insights, your creativity, your energy, your expertise are desperately needed. I don't care whether you are a teacher, a principal, a supervisor, a coordinator, a superintendent. The fact of the matter is you have a role to play in better serving kids.

And so, gang, I give you one of four anti-PowerPoint PowerPoint slides. Okay? This is this ridiculous [inaudible]. It says, what is it that our world exists in? Well, there it is. Look at the difference. I think that there are only four things we have to worry about, ladies and gentlemen. What the hell are we teaching? How are we teaching it? How well are the kids learning it? Within what ambient professional culture?

In other words, we need to have a curriculum that makes sense, that is aligned, that has a pacing guide, that gives us the materials, that has the technology available. We need to convey it in

great ways. So we got great materials now, but it's not very well conveyed. Or we have mediocre materials that are not giving teachers the opportunities to do it. We have assessments that then hopefully are aligned, which in most cases they aren't, right? And we have to worry about all those assessments because they're not tied directly to the curriculum and to the materials. And then all within professional growth, within a professional culture, characterized by dignity, transparency, collaboration, and support.

Ask the teachers in your schools, ask the teachers in your district whether or not they feel they operate in a culture. The real difference between urban education in this country and suburban, high class education is all right there. Walk into the schools in Pittsburgh and Philadelphia and other places in general and compare them to what we see in Bucks County and you know the difference is chasmic, as in a chasm. Here's the great news. This is too much! This is overwhelming. It's absurd to have us worrying about this and this. And so, gang, I think that it's simply important that we understand that for large measures, we've begun to see our curriculum is stale. Hence, finally the hope of the common core state standards.

Our instructions is underperforming. There were too many kids in too many classes without the opportunity to learn. Right? Our assessments are mediocre at best. They have nothing to do with, ma'am, what you were asking about, of explain, of show me, of have thinking and reasoning. All it is is a bunch of regurgitation of absurd thing. And our professional development, as you well know, like it or not, is essentially useless. The research is so clear that most professional development is in one ear, out the other.

Well, guess what? This is amazing. Because of all that, the great news is that our curriculum is stale, but into the common core, our instruction is underperforming, it's still a problem. Our assessments are mediocre. We have some new assessments. Our professional development is essentially useless. Welcome to a far more simplified world. And there it is. This is subordinated. This is subordinated and it says that, as leaders, finally we can attend to, let's accept the realities of, a new curriculum with the materials that are forthcoming, a new set of assessments, and all the opportunities to have online assessments that have a higher quality. And darn it, let's finally focus on using the results.

You want to talk about the benchmark assessments in this country? You want to talk about how much time is wasted with acuity and [inaudible] and AIMSweb and what is the NWEA thing called? Come on, you -- the MAPs. Of course, the MAP assessment. Right, oh my god, we have to do it. Put it in. And the weaker the kid, the weaker the school, the more we do that stuff. And then you tell me, when

do you see teachers making any use of that? Honestly, when? You're all nodding because you know that, in fact, it is just numbers and we don't -- if we don't use it, then why are we doing it?

Think about a system like Park and Smarter Balance are talking about, of having an aligned system of benchmark assessments being able to control that stuff from an item bank of high quality stuff in ways that we cannot currently do. And stop and say that, as leaders, given those pieces, our job is to do the two things I want to talk about today. What is a leader's role? A leader's role is to ensure that we have high quality levels of effective instruction every single day in every single class, 180 days a year. And we do it within a culture of professional sharing and transparency and videos and all that kind of stuff so that we break down that isolation.

That to me is what you see in the highest performing schools. Why does Kip work? Oh, they handpicked the kids. Manure. Those kids come from the same horrible places. Why does it work? Because you've got teachers that have no lives. That's why first of all, okay? Why does Teach for America work? Because you take people that have worked 12 hours a day, right, 15 hours a day, six days a week since they have been 12 years old, right? And so they just continue to work at that pace.

And so, gang, why bother? I mean, given all that stuff, why bother? In case there's any doubt, I give you five opening perspectives, okay? Perspective one. I think that you may or may not understand that this year's been tough. This year has been incredibly tough to be a teacher. The simple fact of the matter is Wisconsin has poisoned the well. You know that the best teachers just have this sense of I'm treated like trash. I work my tail off. I have no life. I'm making a difference in my kids. And the world says, you're just a teacher. Screw your benefits, okay? You don't really work hard. You don't work and deserve any of this money. I mean, it's just -- it has just been pervasive in so many ways.

I think that as leaders, we need to go forth and make it clear that what we do is the most indispensable piece of a society to work. And the fact of the matter is, why are there so many issues and problems? It's because this country right now does not have adequate economic security and social wellbeing. I mean, it's not a surprise that there's a tea party. There's not a surprise that there's so much fear going on. There's just this sense of we're losing it.

Well, gang, you can't have economic security and social wellbeing like this country had throughout the 1950-2050 year period without innovation and productivity. That's why business screams and yells. That's why that innovation and productivity are so important. Snap your fingers,

innovate. Doesn't happen. Snap your fingers, productive. No, it happens when the system attends to the development of human capital. As horrible as that is for educators to deal with, that's what we do.

And we provide equity of opportunity. When there's no equity of opportunity, when there's no development of human capital, this society starts to wilt. And so, gang, I remind you that it's high quality education that is the essence of economic security and social wellbeing. Here's my problem. Most policymakers, most people in Harrisburg and people in Washington stop there. They just don't understand that there's anything else. Why can't we have better schools?

You and I understand that the base of the pyramid is what every single teacher does every single day, that the heart of the matter is daily classroom math, English, language arts, science instruction. And when that works, everything else works and we make it. When that doesn't work, we are in problem land. And so my challenge to you is so simple. What do we do to ensure that that is better? What do we do to ensure that, in fact, our worst classes are good, not awful?

That we walk -- so I'm videotaping classes in Alexandria, okay? Michael. Michael is 26 years old. Michael is a high school dropout. Michael is a videographer. Right? Michael and I are going from class to class to class. We are watching the whole thing. We walk out and Michael goes, oh my god. I go, what's the matter? He says, was that as bad as I thought? I go, what made you think that? He says, there was just no learning going on. There was just total disorganization. I said, Michael, is it that obvious? He goes, yeah.

Ten minutes later -- no, three hours later, we walk out of a class and Michael goes, can I put my nephews and nieces in that class? I go, on what basis? He says, did you see how much learning was going on?

In other words, gang, you and I know, okay? I walk out of a middle school, been in classes all day long. I walk into the principal's office, a big smile, and go, just great day. Thanks so much. Oh, cute kids. Is that your son and daughter up there? It's always their son and daughter sitting in the bookcase. That's where they are, right? Do they go to this school? No, no, no, they don't. I go, interesting. How come we both know that if they're in this school, they would both in Lisa's class and not David's class? I mean, you know, I told you I'm not a nice person. You get this. Oh my god, he said it. You know, I mean, this person spent the last five years saying it doesn't make any difference which teacher your kid has when everybody knows that you all know which kids -- which teachers your kids would have.

And so if we know that, if somebody else's kids are being screwed, what are we doing about it? And so, gang, all right, let's be clear. We have to start by understanding that you can't mandate it. You can't simply impose it. You have to help people make those changes. We are being asked to do something that's never been done before. You are useless as a leader if you don't understand that we are now in a world that is no longer satisfied with sorting kids out. We are now in a world that's saying all kids need to get math. All kids need to be ready for college in some way, shape, or form.

The problem is there's no existence proof. There's no roadmap to get us there. Except that is what we profess as professionals. And that is what the world is telling us we got to do. Well, gang, if we're being asked to do something that's never been done before, if we don't have a roadmap, then it should be just as clear that the only way to get there is by doing things differently. Because there is no other way to serve a broader proportion of kids than to teach in distinctly different ways from how we were taught.

Once again, how do you do that in isolation? How do you do that without videotapes? How do you do that without observations? How do you do that without professional learning communities? Am I making sense to you? So it all fits together in that way. And again, there's no existence proof. We don't even agree on what different means.

And so there it is. It says that what does a leader need to understand? A leader needs to have a mindset that says most teachers practice their craft behind closed doors, minimally aware of what their colleagues are doing, often under unobserved and under-supported. Far too often, teacher's frames of reference are how they were taught, not how their colleagues are teaching. Common problems are too often solved individually rather than seeking collaborative and cooperative solutions.

So I'm out in Renton, Washington in December. This is March 1st, right? December, I walk into Jeff's class. Jeff is at Renton Middle School outside of Seattle. He's 24 years old. He is a first year teacher and he is teaching bits and pieces to connected math, the single hardest unit anywhere in the curriculum, and it is like oh my god. Where the hell did you come from? The class ends and I go, this is amazing. You're 24. You're a first year teacher. Where did you learn to teach connected math and kids this way? He says, easy, I sit in Michelle's class first period every day.

Yeah, that's right. Pause and think about that. I said, how did that happen? He says, well, I had a duty period. When -- you know, first year teacher, I had duty period. And we said that's ridiculous, I'm struggling the first week of school, and we realized that Michelle is teaching the same stuff first period.

Went to the principal and, thank god, the principal says, screw your duty period. You go with Michelle. So by the time I saw him third period, he has co-taught and co-planned with Michelle first period instead of sitting in a study hall. He has taught it himself second period. And I got to see him third period.

And you sit there and go, now, how hard is that? And the answer is that's not in our radar screen. We haven't thought about those notions of induction. We haven't thought about those kinds of ways. And so here it is. This is probably the most important slide of all, okay? Because more and more and more when I see where it works, where I see where it doesn't, ladies and gentlemen, people cannot do what they can't envision.

That's why I keep talking about observations and debriefs and about videos and those kinds of things. People can't do what they don't understand. People don't do well what isn't practiced. That's why professional development doesn't work, because we never have opportunities to practice it. And the reason why coaching is so critical is because practice without feedback, right, results in very little change. And as you all well know, right, the fact of the matter is that without collaboration, none of it is ever sustaining.

And so, my friends, there's our job. Our job as teacher, department head, principal, math coach, leader, assistant superintendent, director of curriculum, superintendent, assistant superintendent, our job at its core is to help people envision. What does it look like? What does it mean? Now go try it. Our job is to help people understand. Fractions is screwy. Well, let's go do it.

My wife currently is working with the race to the top project in Washington D.C. Okay, Washington D.C. with 37,000 kids in charter schools and 44,000 kids in the regular school has finally built teams. So Anne works with five different teams, two charter school teachers, and two regular school teachers coming together to do lesson study, video development, and professional development interaction around little vignettes for kids and for teachers and stuff like that. It is unbelievable the chasm between the two pairs of teachers. It is unbelievable how much just helping people envision builds the understanding where it's safe with four people and a coach who has no supervisor responsibilities.

A special ed fourth grade teacher at the E.L. Haynes school is sitting there struggling with something and Anne says, well, dah dah dah dah dah. And he just goes, I didn't know that. And Anne and I have dinner that night and we go, hey, that's the real world. She says, how could everyone not

know that? And we know the answer to that. There hasn't been that opportunity. Provide feedback and provide collaboration.

And so gang, comments, questions? I have just raced through an introduction. My next slide says, so it's instruction. Ma'am?

AUDIENCE MEMBER: Have you been to a school where you've seen those elements?

STEVEN LEINWAND: Yes, I have been to any number of schools where I have seen those elements. They tend to be high performing suburban schools or not so suburban, more diverse, but with strong leadership at both the teacher level and the administrative level. And so, yes, I am in schools where I see regular K, 1, 2 PLCs. Once a week, those people come together for an extended period of time to talk about math, talk about kids, talk about instruction. And then there is a 3, 4, 5 team. I am in schools where the middle school math department basically runs -- come on.

You know that if you have eight people in your middle math department or in your high school math department, they rule. They have more power than anyone in the whole district. You can't tell them what to do. And if they are doing it together, get out of their way, for better or for worse. If what they're doing is good -- and so, yeah, I'm in places where the math department has come together, starting with two people, and then three, and then four, and then they hire, and then they intimidate two of them out of the department.

I mean, you know that's the way it works. And then they build a crew where they call me in only as a critical friend. They call me in only for the really hard problems and to get validated that, in fact, they are regularly sitting in each other's classes. They are having discussions about what the hell that statistics in the new common core state standards really means. Right? They are regulating each other.

I'm in a school, ma'am -- whatever. I'm in a school where you cannot teach honors algebra one unless you have sat in an honors algebra one class at least once a week for a year. So, and those are the things that are existing. And yeah, I mean, none of that is pie in the sky. You know, and there is just this sense of we're in this together. We share. I am in schools where, when the tests come off of the Xerox machine, someone walks over and goes, you're asking kids this stuff today? And sometimes they're saying it with a smile and sometimes not, all right, but it engages people in a discussion. Is something wrong with this? I mean, would you do it differently? Oh yeah, look at my test. Well, how come it's not a shared test in the first place.

So yeah, and guess what? People grow. People grow pretty quickly. It's breaking down the isolation. Ma'am?

AUDIENCE MEMBER: So as a parent of a child in a public school, what can I do to influence my teachers, my administration?

STEVEN LEINWAND: There's only one way you can do it as a parent, and that is you identify the two superstar teachers that love to teach, are doing great things for your kids, and surreptitiously say, how do we infiltrate this school? You've got to start from the inside. I don't think you can do it top-down. And I think you know that there are probably two teachers that are amazingly talented. In my experience, one will glom on and willing to do it. The other one has got too much on her plate.

I mean, Denine in Hazelwood, Denine is 36. Denine is a high school dropout. Denine has got this long, long red hair. She's basically a modern day hippie who drives a Harley-Davidson. She is a teacher that you would simply go, oh my god. I brought the special ed aide into her room. Large African-American woman, been in this school for two years, totally fed up with all these kinds of things that are going on before the turnaround. She literally started to cry when she watched what Denine was able to do with her kids. Denine will not assume any leadership role because, as she puts it, I'm a high school dropout, my grammar sucks, and all I care about is teaching.

So I can't get her to do -- it's fine, okay. Denine, your job then is to be there so that I can send people into your classroom. And then you love talking to your colleagues. That's her role in the thing. So Jimmy, on the other hand, who's a TFA guy who's going to Yale next year, more ammunition against Wendy Kopp, but that's a personal issue. Jimmy has done things in the two years he's been there to really bring together and lay foundations so that when he leaves, Kendra is going to pick up those pieces. And so they're doing it within that department.

As soon as I tell you that, the science department is almost as strong. The English department has got some real issues. But I got a great math coach; I don't have a good language arts coach. So as a parent, I think that our options are really limited.

What else? Hey gang, so let's do this quickly because, again, you need to envision. You need to know what to look for. You need not to just sit there and say, oh, well, I already knew that and stuff like that. Because the fact of the matter is there are specific things that we can do. Virtually all young children like mathematics. They do mathematics naturally. They discover patterns; they make

conjectures. Oh, it's so cool, right? Natural curiosity is a powerful teacher. Watch in a first grade classroom. It's so neat, right?

Unfortunately, there it is. Unfortunately, as children become socialized by school and society, they begin to view mathematics as a rigid system of externally dictated rules governed by standards of shut up, sit down, accuracy, speed, and memory. You are looking at the mathematics of 1850. You're looking at the mathematics of 1950. If you want speed in this day and age, where do you go? You go to a calculator. You go to a computer. You want accuracy? You'd be fired if you were doing long division on the job. You all know that. Come on, look around this room, okay?

You know, every year I am closer and closer to the oldest one in the room. There are only four people in this room, that's it, who can actually remember walking to a bank, handing the teller a quarter. Oh, good morning, Stevie. Would you like to deposit your 25 cents? As the teller pulled out a ledger card and used a pencil to record -- yeah, there are four people in this room nodding, right? There are 90 people in this room going, what the hell are you talking about, dude? I mean, there actually was a time when people did computation in front of you, right? I mean, I'm old enough to remember in the delicatessen, they did mathematics on a brown paper bag. I mean, I'm sorry, I go to these food stands and out comes the calculator. I mean, that's the only way it's done in this day and age, right?

So their view, because of the way it's been taught, is like leave me alone, man. The view shifts from enthusiasm, this is so cool, to no, don't give me that work problem. From I can do this to, no, I'm stupid. Right? Eventually most students leave mathematics under duress, convinced that only geniuses can learn it. Oh, speed, accuracy. On your mark, get set. Come on, boys and girls. Tell the person sitting next to you what the formula for the volume of a sphere is. Go. Come on, it's on every Pennsylvania test. Exactly right. That did it. Excuse me.

Look at how easy it is, right, for me to help you envision and understand. I ask you one stupid thing. I don't know. Four-thirds? Two-thirds. That's right, there is a formula sheet. Wonderful. Are you happy? So how come we have the formula sheet on the thing and still 70% of the kids get that item wrong on the eighth grade and the 10th grade test? And the answer is they don't know what the hell that means. And so really, gang, excuse me, what's four-thirds? What is instruction? Instruction is not shut up and memorize the formula that god gave us that no one understands. It is not mathematics. It's totally alien. It is, wait a second, where did this come from?

What's four-thirds? I can't hear you. That's right, it's an improper fraction. Good, what's four-thirds? It's one and one-third. What is that called? A mixed. Now how did you go from four-thirds to one and one-third? Ooh, that's an important discussion, right? Well, I knew three-thirds was one and that kind of way. Oh, how interesting. Cool. What's four-thirds. 1.333. Actually, it's not thirds, but it's sixths. Oh, so it's -- it's a eight-sixths. Where did that come from? How do you know and all those kinds of things? Nice, good.

What's that R? Boys and girls, what's R? Don't you feel good? It's the radius. Oh yeah, I knew that. What's my next question? Yeah, my next question is what's the radius? Watch this. What's the radius? Yell it out. It's half the diameter, good. And I -- that's my answer, right? So a bad teacher sits there and hears the five smartest kids call out the answer. The rest of the kids are sitting going, dur. And I'm happy because I got the answer that I would have given. No, no, no, no, no, what's the radius? Oh, it's -- it is half the radius -- half the diameter. It is the distance from? Good, so how many radii does a circle have? An infinite number. How could it have an infinite number? Because there are an infinite number of points on that line called the circle, which isn't a line but a curve. How interesting. So we got R.

What's that little three called? I'm confused. Come on, gang, every one of you knows the most common mistake in all of middle school and high school, R is two. Six! R is two. Six! I multiplied. You're all going, very simple! All we do is say, here's the formula. Go plug it in, right? Wait a second. What does that three mean? What is three? Three is called an exponent. What is it?

And then the best thing of all, what's that little thing that looks like a table? What is that? Oh, that's pi. Good, what's my next question? What's pi? And you all scream out? 3.14, wonderful, that's right, delicious. Apple, peach, pumpkin. That's all it takes to have kids go, you know, math was almost cool. Math was almost cool today. I actually, you know, paid attention. I put my iPad down for five minutes because we started talking about apple pie and then pie. And pi is 3.14.

Excuse me, gang, pi is proof that god exists. Pi is where they let us bring religion into schools because only the deity of some sort could possibly have given us the fact that the ratio between -- no matter how big or small, there's always this constant 3.141 duh duh duh duh. Let's go try it. Let's go see. Pi and circles are like peanut butter and jelly. They go together in all those ways.

And so, gang, look what I've done. I have moved from accuracy, speed, memory, plug the stupid thing in, get the answer that no one cares about, to instead a world of what does it mean, where does it come from, and all those kinds of things.

And so in case you don't understand what's going on, in case you don't see why we have to attend to instruction -- so late one night, Alan Schoenfeld's research out in Berkeley. Morning. I'm Alan Schoenfeld. Got my graduate students. You said that I could spend the day here in your elementary school. You understand that I'm supposed to show up in some first grade classrooms and some sixth grade classrooms, right? No problem. Schoenfeld, enjoy the day. Cool.

Schoenfeld walks into the first grade. Good morning, boys and girls. I'm Alan Schoenfeld. I work up the hill at Berkeley. I have a problem for you. Boys and girls, oh, you're a good looking bunch of first graders. Late one night, a shepherd was guarding his flock of 20 sheep when, all of a sudden, four wolves came over the hill. What do you think most first graders say? Schoenfeld, that's right, they all jump when Alan Schoenfeld asked, boys and girls, how old is the shepherd?

Come on, how many of you have a six-year-old at home right now? So you go home tonight, right, six-year-old. Hey, 20 sheep, four wolves came over. How old is the shepherd, Robbie? What do you hope Robbie says? Dad, you're a jerk, right? Basically, right? I mean, how the hell do I know? How would I know? That's a stupid question. That's nonsense. That's what they say. Two-thirds of first graders said to Alan Schoenfeld, how do you know? That's a stupid question.

You know where this is going, don't you? Yeah, [inaudible]. We go right down to sixth grade. Boys and girls, how old is the shepherd? Three-quarters of the kids, 24. Two numbers, add them. You laugh either because you know that those are the kids you work with. You laugh only because I am simply holding up a mirror to what happens. Or you're laughing because you realize that that's pathetic. But that's the situation. We have so focused on answers without understanding. We have so ignored reasonableness.

In fact, I think that we need to just be honest. When the great history of No Child Left Behind is written, we need to acknowledge that finally we tried to build an accountability system tied to standards. And it was a first approximation. And that's good. And secondly, we disaggregated data. In 1992, when we were building a new generation of the state test and I said it's about time you put the race question on, it was no, we're not allowed to ask that question. It took No Child Left Behind for us in

Connecticut to finally get to the point where we saw just how stark and unacceptable the gaps were, the things we didn't really want to know about before. That is good and we ought to honor it.

But you all know that this mad cap every single year and the budgetary stuff gave us a test that basically reduced to multiple choice drivel. And that is what we are now trying to dig our way out of. In other words, how do we have a sensible, aligned accountability system that I want to teach too, as opposed to one that basically says today the objective -- all that counts is you getting an answer because on the test you can outsmart the test by looking at the things and knowing that these two are ridiculous. And therefore, you pick between these two. And we only worry about the bubble, kids, screwing these and screwing these. So those are the strategies they've used, and it's time for us to recognize that that does not serve kids.

And so there it is. The problem is we continue to do what we've always done. Guess what, gang? We're going to continue to get what we've always gotten, duh. Well, what great instruction. Boys and girls, the critical objective for today's class is for you all to be able to parrot. If we continue to do what we've always done, we will continue to get what we've always gotten. In one ear, out the other, all here, never here. What is good instruction? We don't just tell kids. We show kids. We engage them.

If we continue to do -- oh my god, feast your eyes. There it is. All across Pennsylvania right now, they're sitting there in second grade. Shut up, sit down, get the answer, get the next one. The weaker the kid, the more they love this. You know. You see the special ed classroom, they love -- don't bother me. I don't have to do it. I can take this thing and when I'm wrong, no one cares about any of that stuff.

If this is the pavlovian stimulus, allow me to take you to a Connecticut second grader's journal. Ladies and gentlemen, the pavlovian response if I were 100 years old from a second grader. If I were 100 years old, you ready? If I were 100 years old, I would go a nursing home. I would stay there until I was dead, just like grandma. By the time I was 100, I would know regrouping with subtraction, and then I would die happy.

I'm sorry, that's just a stupid example. I mean, you know, this is what's important. No, gang, they work together. It is the objective. It is the how. It is what it looks like. It is engaging you in that stuff. you think the problem is only second grade? I told you algebra two is my arch nemesis. Look at this. Look at this algebra. This is unbelievable. Lookit, lookit. You understand that you are looking at mathematics that no one on the planet does outside of a school classroom?

I fly all over the place in these first class cabins, right? I sit next to these engineers. I sit next to these guys that do all this -- they look at me and they go like, what is that? I go, what do you mean what is that? You just told me you're the director of engineering at John Deere. Goes, we wouldn't do that. He says, we have computers for that. It's like you sit there and go -- I'm sitting there and, I mean, here, oh, but engineering, you need this. We continue to use this to sort kids out in preparation for a world that doesn't need these things.

Page two. Oh, just look at how much better it gets. It's like, oh, I'm sorry, you believe that it's any clearer this way than it is this way? Division of polynomials, it's just so great. And there it is, gang. Congratulations, you had a great math program.

So I got you loosened up, gang. Okay, I've made the case that we need to make some changes. And so what have we gotten? We need to be honest that we have set kids up, we've set teachers up, that in fact this common core state standards actually has features of fewer objectives, more clarity, more depth, more richness, and more teachable in terms of the placement and the coherence that, in fact, give us a chance that we reduce this, that we have less illiteracy, that we have better test scores, that we have better high school programs, that we have the remediation that makes sense in all those way.

And so it's not a very pretty picture. And we want to be able to say, what do we do about that? Not because of the public, but because of the kids and because of the economic future of this society. And notice I haven't yet talked about India and China and Finland and Singapore and all those things. And I'm not because that horserace is simply not as important as what every one of you knows. And that is there are too many kids leaving fifth grade, leaving eighth grade, and leaving 12th grade inadequately prepared with things like core statistical understanding, core understandings about algebra. Not algebra two and calculus, but an ability to handle proportions and ability to know when and why to add, subtract, multiply, and divide, and what button to press on a calculator.

And if -- finally, what we've always gotten is no longer acceptable. And as leaders, it is our responsibility to oversee changes in some of what we do and a whole lot of how we go about doing it. I'm going to skip over this and tell you that there's the second anti-PowerPoint PowerPoint slide. There's the summary. And we need to now put life into these things. If I could waive a magic wand, ladies and gentlemen, it is just this simple and it is just this hard.

Research, yes, there is a research base for everything on this slide. But more importantly, it is classroom observations. It's seeing when kids are learning, touching, and feeling. And it is common sense that provide a great deal of guidance about those practices that make significant differences in student achievement. I get to see those practices in high performing classrooms and schools all across the country at all different levels and all different places.

Effective teachers make the question, really, why? How do you know? Jonathan, how'd you get that? The teacher, where'd that come from? How do you know? Can you explain that? Right? A classroom mantra that supports a culture of reasoning and justification. Teachers incorporate daily cumulative review every single day to keep those skills up to speed. Cumulative review. Lessons are deliberately planned. We don't punt. The reason why the SMART Board and the Activeboard and doing instruction on whiteboards off of LCD projectors and PowerPoint is so powerful is simply it forces us to plan.

I have a video of me teaching the low-level 11th grade algebra one class at T.C. Williams classroom. 18 African-American males from a quarter to two to a quarter after three. We'll show you, hot shot. Why don't you come on in and teach a class, and we're going to video it? I loved it. I prepared the class on PowerPoint and it blew my mind that we went from one thing to click, and that was it.

I sat in a class just last week where the teacher lost the kids in, and now we're going to talk about a table. And we have tables and there are miles and there are hours. And I check my little crib sheet and I put it in. Ladies and gentlemen, today's world of instantaneous response kids cannot and will not. They start, their mind goes other places. We have got to click a button and there it is, and we ask questions and see it. That is why the technology is so powerful. It forces us to plan better. It allows us to display it.

I'm in classes where we go over homework. Ahh, ahh. I'm in classes where, who did it differently? And out comes the document camera. The work is there. It's instantaneous and we see it. And we look and the question is, who did it this way? Pause. Who did it differently? Let me see it. Put it up here. Ah, and now we have a discussion about the two different approaches to that thing. That is how we went over homework. That was it. That is part of what is possible.

Right, teachers plan, skillfully employ alternative approaches in multiple representations, including pictures and concrete materials as part of explanations and answers. And they rely on context to give kids a reason to care. And so you've got these slides, you've got a handout that actually has the

vision of teaching and learning that you can actually see that I worked on with the union in Louisville, Jefferson County, that doesn't have a checklist, but that has paragraphs for 12 strategies that make a fundamental difference. And so, gang, read it to me. Let's go, read it to me. Because this is what everyone needs to understand. Jane went -- oh, very good. All together now.

AUDIENCE: Jane went to --

STEVEN LEINWAND: Oh, wonderful. You are such good readers. Boys and girls, we are now in a Title I closet in the basement of the building. It is a little room. It is musty and no one likes to be there. We call it the Title I dungeon and we have a mediocre remedial paraprofessional working with kids. What's the next thing out of that para's mouth? Come on, you know what this -- you teach reading. What else would you ask? Who went to the store? Answer?

AUDIENCE: Jane.

STEVEN LEINWAND: Good, next question, please. See, you guys understand all this stuff. This is easy. I know exactly what we ask. If you are a math teacher, you believe that we're done. If you are a remedial reading, mediocre teaching, you have a script that says -- yeah, why do you think Jane went to the store? How many of you know? That's right, but that doesn't stop us from answering the question. Kids sit there and go, she needed cigarettes. They ran out of peanut butter.

You know one of the great, amazing things that mathematics is? We say, I teach mathematics. My job is to teach kids to reason. My job is to teach kids to think, to use logic. And then all we do in mathematics is 75. We never ask, how did you get it, right? Where did it come from? And we don't ask, is it reasonable? So I say to you, look at why reading works better than math.

Look at why even remedial reading works better than most traditional math. It's because in reading, we all understand that learning, that brain growth, that neural connections all emerge from comfort, easy, comfort, easy, regurgitation, I'm in the loop; to hm, pause, think, infer. Needed peanut butter. Needed to go get stuff for lunch. Needed shoes because we lost them in the locker room. To is it reasonable? Do you think it made any sense? Not if she left the kids home alone. Not if it was past their bedtime. Then she was just irresponsible. Kids have got no problem with that.

I'm sorry, you understand all that, so take out your math homework. Oh, very nice. Good, good work. Greg, homework. Again? Yeah, dogs and buses, I understand all that. Good, number one, 19. Any questions? Of course not. Why would there be any questions? Half of you are saying, well, of course it's 19. The other half of you are crossing out 18 and making it 19. Oh, there is such learning going on. Yeah,

you see I'm laughing, you're laughing, okay, until you videotape this stuff and let people hold up mirrors and go, what a waste of time. Right? Number two, good.

This is why smart teachers put the damn answers on the board. They're sitting here. The kids walk in, we do the warm-up, and then we turn to the answers and the question is, which two problems should we go over? Check it with your neighbor's work. This is why in the pile of stuff that you get upstairs, Pennsylvania has this thing on -- PaTTAN, right, has a teacher notebook guide on homework. Rip it up. I mean, it basically says high school kids should be doing three hours of homework a night. Give me a break. You want to talk about parents? Okay, how many real minutes does your kid have to do homework between sports and catechism and music lessons and family dinners and stuff like that? No kid should be doing more than an hour of homework total any night, right?

Mathematics, 15 minutes, 20 at most. Give me three problems on the new skill. I don't want to poison kids. If they can't do it, I don't want them to do 10. Three today, three later. That's called distributed practice. That's what the research says. And we don't follow any of that stuff because it's the way it was always done. And because if we don't, two parents complain. Your job is to intercede and tell the parents, screw you, the teacher has my support. Oooh, ooo.

Number three, oh, 185, any questions? There are never any questions. Why would there be any questions? The kids go, this is dumb. No why, no how. In other words, none of the things that grabbed you when I asked what's R, or when I asked you why the containers, thank you, the water, thank you Sabra, worked in that way. All of the stuff that gives kids a reason to care. And so we start class off every day with, take out your homework. That's the same old stuff. I can just tune out because it makes no difference. And you see kids just know it makes absolutely no difference.

And so, ladies and gentlemen, there it is. Very practical. You know that if we adapt what we know from reading, we can improve the quality of mathematics instruction. We know that it has a direct effect on neural connections and we can monitor it and we can see it. Ready? On the back of the handout, all of you, ready? You got a piece of paper. Number from one to six. Let's go, all of you. I need you to do this. One, two, three, four, five, six. We said why is the most important thing that can be asked in every math class.

I said to you that I'm amazed at how many classes I now see teachers doing warm ups. I'm part of a book group with 30 teachers in Michigan now who are reading my Accessible Math chapter by chapter, one a week. Last week, they read the ongoing cumulative review chapter. I have five pages of

their tweets and comments. It is so humbling. It is so humbling to write a book that comes from all of my experiences in 3,000 classrooms to write a book that I write in Islamabad, Pakistan when I was in a prison in a hotel every night because it wasn't safe.

That hotel was blown up by the Taliban three weeks to the day after I checked out. I had three colleagues in the building when the bomb went off. They all got out. Of the 40 people that were killed, 32 of them were the people that kept me safe for the two weeks that I was there. They ran the grate. The grate kept the truck out. They ran the magnetometer in the lobby, wiped out. They were the uniformed greeters, wiped out. And eight people at the front desk that were in the lobby at the wrong time at the wrong place.

This Accessible Math is an opportunity for me to see teachers saying, I didn't think of that. Oh, I do it, but I don't ask the questions as systematically. I don't use it. And so, ladies and gentlemen, number one. What's the product of six and seven? Do not yell it out. I'm going to do this really quickly. Number one, what is the product of six and seven? Good, I read each one twice. I expect that you know what the answer is, that you can write it down. Number two, what number is 1,000 less than 18,294? Boy, I was really upset by that place value stuff that we did back in September. Doesn't seem to be on top of things.

Number three, the estimate of the day. I just bought two items, boys and girls. One was 32 cents, the other was 29 cents. Next to number three on your paper, would you please tell me about how much did I spend? Great, number four is the only item that I need to see how well you do to decide where to start teaching today's class. Number four, about how much? No, exactly how much is a tenth of 450. If most of you know this, I'm in fat city for today's lesson. If most of you don't, I better go back or otherwise I'm wasting my time. I use it for diagnosis.

Number five is a pictorial daily double. Would you please draw a picture that a normal human being would look at and say, holy moly, that's a picture of the mixed number also known as one and two-thirds. And so I love to watch which kids simply tune me out, which kids are drawing little circles, and which ones have got Hershey bars because we're in Hershey, and which ones are shading in their window panes, and which ones have computers and they can't draw and they can't write anymore.

And because I am compulsive -- I'm sorry, but if another administrator tells me they do data-driven instruction, I'm going to tear them limb from limb. I went to the ASC conference on data-driven instruction! And I sit there and go, yeah, what have you done about measurement? I mean, we've

known for 30 years that measurement sucks in Pennsylvania. It sucks on NAPE, it sucks on TIMMS. Measurement is awful. We do measurement in the worst possible -- does it change anything? No. Do we move the metric to science? Do we do more stuff? No. So every single day, how much do I weight in kilo -- oh! No, that's not fair. I don't know. How can you do that stuff?

Hint number one, I weigh less than 10,000 kilograms. Good news. Hint number two, I actually weigh about 195 pounds, about 10 pounds more than I should. It's called the good life. You leave number six blank, you get a zero for the entire quiz. Oh, you better estimate, my friends. On your mark, get set. Write it in. Switch papers. Ba da bum bum bum bum bum bum bum. Switch papers.

This is unbelievable. Ladies and gentlemen, it is now third period on a Thursday morning. I have just given you six of the stupidest, nakedest, dumbest, decontextualized math problems known to man or woman, and look at you. What'd you get? Here's the way to measure -- oh no. See, you're laughing. If I can get you to care -- that's why teachers say it's unbelievable, right? And when you share the papers, guess what? You get honest answers. On your mark, get set, look at the paper. How many of you are looking directly at your own paper? See, you won't admit it. I told you to switch. You're worse than the kids. Love it.

Raise your hand if your paper has an answer other than 42 for number one. Oh, oh, talk about pride. Talk about pride. Ladies and gentlemen, boys and girls, we've been working on six times seven and seven times six and 42 divided by six. I do the fact family, I remind them, right, since the first of the year. We're down to only two students in this class struggling. Do you remember that it was nine in October? That's -- and every kid is going, yeah, we're so much smarter. Yeah, we've learned it.

Tomorrow, Friday, first item on mini math, you ready for this? Nine times six. What's the answer? Cool. That's called cheating. No, that's called advanced organizer. That's called anticipatory set. That's called if they can remember it between today and tomorrow, there's a chance they can remember it between Friday and Monday. It's telling kids that, in fact, if facts are so important, I'm going to stand on my head and I'm going to take affirmative action with facts. There is a fact -- you know how wealthy I would be if I had a dollar for every teacher in this country that walks into a teacher's room saying, if only they knew their facts? If only they knew their facts. What did they do in the previous grade? If only they knew their facts. If they don't know their facts, then we have to take some affirmative action. We have to deal with the strategies and those kinds of things to deal with them. It's not just memory.

Good, my paper says 17,294. What did I change? I changed the eight. Good, I changed the 8,000. I changed to 7,000. We could have all -- excuse me, that is how many people showed up at Penn State last night. Oh. The paper said about 20,000 show up, Penn State basketball game. What'd they just do? They estimated. They rounded to the nearest? Nearest? 10,000 nice. Actually, there were 18,000 there last night. I rounded to the nearest? 18,000, nearest thousand. Oh, this is wonderful. This is great.

So now I sit there and I go, excuse me, boys and girls, remind me that the last 10 minutes of today's class is a review of place value. All right? I stop and say, this is on the test. I stop and say, this is critical. I stop and say, I know I taught this, but I taught it -- and how I taught it. What is the value of the two? Who cares what the value of the two is, right? What digit is in the hundreds place? That's what's on the stupid test. That is not what is on the new round of tests, okay? The new round of tests, I've seen some third grade prototype items. And in fact, it is really about rounding and which is closest and how do you know and those kinds of things. It is write the number that would be 20,000 if you rounded it to the nearest 10,000. It is building on critical understandings and not mindless stuff.

Raise your hand if your paper says 62. Full credit. Raise your hand if you have 61. Look at that, 61, 61, 61, 61. Full credit. Ooh, that upset some people. Raise your hand if you got 50. Full credit. Raise your hand if you have 60. Oh, you goody, goody two shoes. Ladies and gentlemen, 60 gets full credit and you ought to be very proud of yourself that you knew that 29 is 30, 32 is 30, and it's 60. You're a moron for doing two roundings when 29 is 30, 30 and 32 are 62. That's a great estimate. 20 and 30, front end, 50, close enough.

And you know that in every single one of your schools, when kids write 61, I said about! I said to estimate! We just chop kids off at the knees. Why would any kid estimate if they can get the exact answer? If they can mental math and get 61 like you and you and you and you, right? Or you sat there and said, I didn't read it. I didn't hear it. Who cares? I got the answer. Thank god. You see, that's how we control kids' whole self concepts. That is what we never catch if we don't coach, we never catch if we don't see that on video and have discussion.

I'm in schools where the math department wanders in, and afterwards goes, I can't believe you did that. Well, let's talk about it. Oh yeah, that was pretty stupid, wasn't it? Never happens again. I mean, those are the ways in which we grow, right? One-tenth of 450. Sure the answer -- my question to you is convince me that it's 45. Just look at the difference. I'm in classes now where, boys and girls, convince me that it's 42. What a difference then. What's the product, right? Ready, go. Tell the person sitting next to you why it's 45.

Okay, gang, so how many of you heard from your partner you chop off the zero? There it is. Wonderful. That's a smaller number than I would have expected. There's nothing wrong with that except that the response is, nice, you chopped off the zero. Why did you chop off the zero? And that's what I want to know.

It's the understanding -- excuse me, I'm not sure you understand what I'm doing here. The common core state standards talk about in second grade 10 more, 10 less, 100 more, 100 less. In third grade, 1,000 more, 1,000 less, right? I mean, in fifth grade, a tenth more, a tenth less, a hundredth more, a hundredth less. That is place value understanding. The common core state standards talk about multiplication facts and multiplying, dividing by 10, 100, 1000. After basic facts, multiplying, dividing by 10, 100, 1000 is the single most common mathematics that we do in our daily lives. That is command of the system. That is why that's so important. And so we have to do it.

And so until I have every kid saying, it's 45 because, well, a tenth of it means it's smaller. It's smaller by a factor of 10, so you just move the decimal point or you chop off the zero. Or a tenth of that is. Excuse me, do you notice that multiplying by one-tenth is the same as move the decimal? Yes, as dividing by 10. Oh, that's amazing. By the way, you know that the flip side of that is that dividing by one-tenth must be the same as multiplying by 10. My god, that's invert and multiply, but that's much too complicated for today's lesson, right?

Kids draw out all kinds of stuff. I tell them to tell me what it is. I'm not going to spend any time on it. I weigh about 195 pounds. I weigh about 92, 93 kilograms. Good news, gang. Anyone in this class had an answer for number six between 50 and 140, full credit. Nice estimation. Hand the papers back.

Hey gang, so look at this. In second grade, I walk in. Good morning, boys and girls. How much bigger is nine than five? Not what is nine minus five. How much bigger is it, right? What number is the same as five tens and seven ones? What number is 10 less than 83? How long is this pen? What about the diagonals? I mean, I ask every day. I sit there, right, I incorporate ongoing cumulative review into instruction every day, and I make a difference in kids' lives.

Almost no one masters something new after one or two lessons and one or two homework assignments. And that's why this ongoing cumulative review is so important and so powerful at the beginning of every class. It says that you think about the term they need to know, the estimate, the picture, the skill. What is it that I taught three weeks ago? What is it I taught a long time ago? What is it

that by benchmark acuity map test tells me is on the end of year test and that kids still don't get it? What do I have to review? And that's the way I do it.

Take a deep breath. Tell the person sitting next to you three things you see on my board. So I've been doing -- I've been doing this tell me what you see for a long time. Gang, okay, forget that one. Tell me what you see. Okay, you understand that this issue of I see a mixed number, I see an improper fraction, right? I see a two. I see 2.25. I see two and two-eighths. I see 2.250 and all those kinds of things. I see nine-fourths. Oh, I have this brain dump. I go, really?

Who saw a mixed number? Convince me it's a mixed number. And we have this discussion. Who saw an improper fraction? I don't see an improper fraction. Oh yeah, but it really is nine-fourths. Why? Not because god said two times four plus one is nine over four, but because this is four-fourths and four-fourths are eight-fourths and one more. I have other kids that draw a picture of it and have that stuff. Look at the power of tell me what you see.

And so I'm out in not Tucson. I'm out in Tacoma. And so I did a workshop for all the K-5 teachers for the district. We did all this stuff all afternoon. And I'm back in this one school two months later. And I'm sitting there going, wait a second, didn't you guys -- what are you doing here? You were in the other workshop? It's the same workshop. I hate that. I hate that.

And teacher says, I came back because I need a second dose. I go, a second dose? She said, so I started practicing tell me what you see with my fifth grade class. She says, this has been the class from Hades. I've got the school bully sitting in the back. I've got two special ed kids and I've got Grunhilda one and Grunhilda two, also known as the aides for the autistic kids, who make my life 1,000 times harder. I go, oh my god, is it going to get better next year? She says, it better be because I can't handle this. I said, so why did you come back? She says, because after you were here two months ago, I said to my class, tell me what you see. And it was so open and so open-ended that Susie, the special ed kid in the front, called out an answer. The class started to laugh. The bully stood up and said, you can't laugh at her. That's not right. She said, because I asked tell me what you see, the dynamics in my classroom changed instantaneously for the better. I brought my bully into a productive role all because I opened things up.

And so I remind you of what is possible when we talk about empowering kids. Tell me what you see, and here is what I get. I hear two. So write it all down. Come on, I see. What'd you see? Two numbers, good. Two? Two two-digit numbers, two odd numbers. Oh yeah, actually there are three numbers on there if you count the 48 down in the lower bottom-right. Oh, that's not fair. Kids tell me

they see a sentence, right? Kids tell me they see a prime number and a composite number. Kids tell me they see two numbers that are 10 apart. Kids tell me they see their grandparents. Kids tell me they see their math scores. It's the temperature last week and all that stuff. I write every one of those things down. It is called a brain dump. It is called giving kids a chance.

It's all on the board, and then we sit there and go, oh, two odd numbers? Convince me they're odd. All of a sudden, is it important? Is it in my curriculum? Do all kids need to know that they're odd not just because they end in three, which is what comes out, but because you can't divide them. Or you divide them by two and there's one left over if you get the even amounts and stuff like that. Am I making sense? Good.

Kids say there are two two-digit numbers, and I have all of my ELL kids sitting there going, what the hell are two two-digit numbers. Two two-digit numbers. Are you stuttering? I mean, do you know hard that is that I have to make sense that I have two two-digit -- actually, I got three, stupid. Two-digit numbers. What makes them two-digit numbers? All right, all that stuff that comes in in here.

Excuse me, they're 10 apart. Convince me they're 10 apart. Watch this. Add 10. I'm sitting there going, the only answer is you take 10 away because that's apart. That's difference. No, no, no, it's 10 on. I got a kid that says 64, 65, 66, 67. I want to hug that kid. What that kid did is he was smart enough to start at 64. That empowers them. That gives me the reason. That says, yes, can I do it? But listen how this kid added on and knew. Another kid says, of course it's 10 apart. 63 lives upstairs from 73 in the hundreds chart. Never in a million years would my brain go and see that.

Kids tell me they see a sentence. I go, how do you know it's a sentence? Kid says there's a period at the end. Oh, cool. I say, do you know what? The period drops down. Now what is it? The kid says it's still a period. The other kid says, no, it's a dot, you jerk. Oh yeah? But it just moved over here. Is it still a dot? Yes it is, but it now has a different name. Do you know how hard that is?

And now what I'm doing is building language rich classrooms. I build language rich classrooms off of tell me what you see. I write it all down. We ask the question. Convince me. How do you know? Because ladies and gentlemen, when we look at test scores, when we watch kids and teaching, we know that for every three mistakes on average that kids make, two are mathematical and one is language vocabulary terminology. They haven't got area perimeter down, right? They don't see the two, the two-digit, the than. Can I tell you about more and more than? Oh my god, right?

If we don't recognize that we've got kids that don't speak English at home in increasing numbers, to say those -- to say nothing of those that have two parents making millions of dollars who were raised by a nanny who doesn't speak English, and I go on and on and on about the lack of language and how it just screws everything up.

So I do a brain dump. Tell me what you see. Tell me what you see. There it is, high school. That is the single most important triangle in all of mathematics. That is the right triangle with the altitude to the hypotenuse. And all I can tell you is that there are three triangles there: the one on the left, the one on the right, and the one -- the whole one. And they are all similar. And that is why there's trigonometry. That is so important.

And so, gang, create a language rich -- you know that this is not -- now let's be clear. This is rocket science. The average person cannot walk in off the street and do this stuff. But it's not quantum physics. It is teachable and learnable. These are not alien notions to create a language rich classroom, to build from reading and inferential -- inferential and evaluative comprehension, to recognize that this use of terms and vocabularies and word walls. I can't tell you how many classrooms I'm in, the answer is sitting on the word wall and the word wall just sits there as if it was on another planet. Point to it.

So Hazelwood, the school I've been working with, the turnaround school with Jimmy and the TFA and Kendra and all that kind of stuff, right? They took Accessible Math and they created -- Markita, the coach, everyone in the classrooms has what they call the line one clouds. On white clouds on a blue background, somewhere in the room there is why? How do you know? Can you picture it? Explain your understanding. And so I've got a picture that sometimes I put in my slides, sometimes I don't, regardless of the slides.

I'm in a class in that school last month, so we're in February. Actually, I was back there in January. January and the teacher asked the question. The kid gives an answer and they didn't even know why I'm there, they don't know who I am. The teacher does, the kids don't. And kid points to the cloud, basically signaling the teacher, I want you to ask us why because I don't understand. It blew my mind. I mean, that is a change in the classroom dynamics because there are clouds and there's language and all those kinds of things.

Ladies and gentlemen, you all know this. We don't practice it. As a leader, you stop and say, like all languages, mathematics needs to be encountered orally and in writing like all vocabulary. The terms has to be used again and again in context until they become more familiar. It's understanding that sum

means both and that area is covering. Perimeter is my border. My belt is my circumference. My difference is bigger than and it's not just -- you know, I mean, those kinds of -- that's not key words. Those are linkages that make sense to what goes on in these kinds of ways.

Ready? On your mark. Get set. Picture three quarters. Three quarters, three quarters, three quarters, erase it. Replace it with a second, different picture of three quarters. Great, toggle back to the first one. Ooh. Toggle to the second one. Erase them both. Can you create a third picture of three quarters?

Help me. How many amongst your two or three representations, how many of you saw 25 cents, 25 cents, 25 cents? That's it, look at this. Thank god for money. Forget it. how many of you saw three over four in its abstract splendor? Yeah, aren't you good little nerds, right? We didn't talk about the one and two-thirds. So how many of you got pizza pies or window panes and stuff like that, and the pizza was sitting there? I've now basically got everyone raising their hand three times.

Now it gets interesting. How many of you saw four octopuses, four beach balls, and three of them were striped or a different color? No, no, no, no. Hey gang, that's called fractional part of set as opposed to fractional part of whole with pizza pies. Ladies and gentlemen, this is a much better model for multiplying and dividing by fractions. Ooh.

How many saw a ruler or a number line? There's zero, there's one, and saw three quarters sticking on there. Look at that, I got three hands in this whole room see a number line. The common core state standards are compulsive about number lines. Why? Because fractions are numbers, therefore they live on a number line. You know how hard that is? Two-thirds, two, three. Oh yeah, but it really is .6. It really is sitting there. I mean, not .6, but 2.666 sitting there. It is a location. That is hard. You can't do that in one lesson or two lessons. It takes time to evolve, right?

How many of you saw -- oh, I'm sorry. I'm so screwed up here that I've got a whole bunch of you still sitting here saying, your grandparents? What's the unit? What's the unit? Years. What's the attribute? Age. Good. It's your parents. What's the attribute? Length, height, distance. What is the unit? Ooh, inches. Convince me this one's composite. No, this one's prime. Convince me this is composite. I just cut all that off, but you see that in fact we had to go back. No question, I can tell whether a class works or doesn't work on the basis of whether or not, by November, the kids say, wait a second, you forgot about my grandparents. Or, I'm not going to ask that question. It tells me the whole attitude and the demeanor in the classroom and stuff like that.

And so we got this language stuff and we got three-quarters, right? Octopuses and we've got the number line and all that stuff. How many saw a measuring cup? Right, and here's the half cup and the three-quarters of a cup. Who's right? Oh. And what is mathematical literacy? A flexibility and a familiarity with a whole range of those representations, right?

Why does it make a difference? Here we go. All of you, eyes on the board. On your mark, get set. This is absolutely indispensable, gang. Go. Da da da da da da da da da, ba ba ba ba. Forget it. I know -- I know that there are some of you that want to call out the answer. I know that most of you are saying, aha. Forget this. Tell me this. Oh my god, look at the difference between oh no, I got to put this one underneath here. I got to put the equal signs in. I got to change the denominator to four. I got to do it the right way. That's the way your brain works. When I give you money, you sit there -- that's why money is so important. All of a sudden it's \$2.50, \$4.50, less a quarter. So think money, think money, think money, think money. It works perfectly. I have been teaching money for my whole life. Money is how I learned it. Money is how I still think about it. Money works, money works, money works.

And Brandon sits here and says, I don't get it. There is no way that in a human interaction, any teacher can do anything other than communicate to Brandon that we think he's a moron. What do you -- I mean, I'm sorry, but if money's always worked, I mean, Brandon is -- god damn you, Brandon. What's your problem?

Gang, the reason why this is rocket science is that Brandon needs inches or cups. And as soon as I say to Brandon, think about measurement and think about cups, he goes, oh, two and a half cups and two more, less a quarter. I don't know why Brandon's brain doesn't work for money, but I do know that I have a responsibility to find a different representation that gives him the tool.

Excuse me, I'm not sure you have any sense of what I'm really talking about. So I have 800s on all those tests, all my GREs and my SATs. I mean, you know, all kinds of great, you know, valedictorian crap and all that stuff. I know every single multiplication and division fact without a glitch instantaneously. Put me at a computer. You ask me eight plus nine, I practice eight plus nine all the time. I talk about eight plus nine. I write about eight plus nine. All the talk and all the practice and all the grey matter does not solder a neural connection that never formed because I had the mumps in second grade. And it's just that simple.

Thank god for the crutch, for the stent, which in my case is eight and eight is 16 plus one. There are people in this room that when I say eight plus nine, your brain says 18 less one. There are people in

this room that go 17. And I go, that's cool that you have a perfect neural connection. I go, what about eight plus seven? And you go, uh, uh, 14 one. You all know that if as smart as we are, we have those glitches, you know that there are people in this room, seven times eight, and you need to kiss the floor upon which a fifth grade teacher walks. Because even now at 47 years of age, you're saying seven, eight. Five, six, seven, eight, 56. Nine times six, you're doing -- you laugh.

So gang, it says that we need to laugh about the fact that there's no perfect lesson. We said that. There is no perfect understanding. There are crutches and relationships and representations that are so key. And so, gang, draw pictures. Why -- come on, I need you to see why it works so much better in Singapore. I need you to see the chasm of difference between the one right way to get the one cockamamie right answer. On your mark, get set.

Boys and girls, CT packs her clothes into a suitcase. It weighs, suitcase enclosed, 29 kilograms. Raheem, Raheem's a dude. He packs his clothes in the same suitcase, identical suitcase, it only weighs 11 kilograms.

You understand that I'm married to a woman, we go away for four weeks with carryon. We show up at the airport and they go, are you going to Australia for four weeks? And we go, yeah. This is all? Yes. I mean, there are bathrooms to take care of laundry and a couple of hotels along the way. My sister-in-law cannot come to Washington for two days without two suitcases. Boy did I luck out. I mean, I have a wife that understands that there is either carryon or lost, and it works beautifully.

So we have [inaudible]. CT's clothes, it must be mathematics, are three times as heavy as Raheem's. What is the mass of Raheem's clothes? What is the mass of the suitcase? Ladies and gentlemen, what else could you possibly do but set up your variables? CT, three times Raheem. Raheem -- CT and the suitcase, 29. Raheem, now go play mathematical games. Now go move and substitute and then subtract and then make it all work.

Oh, I hope you're all happy. And I think that you know that there is no way in hell that we're ever going to have every single kid do subtraction with regrouping the way in which god said it's supposed to be done. And we're never going to have all kids do two-digit long division. Never have, never will. But that doesn't mean that they can't do division. And it means they can do algebra this way.

So if CT's clothes are three times Raheem's, I don't need X. I got a box. CT, three times Raheem's. CT and the suitcase, 29. Raheem and the suitcase, 11. Boys and girls, how much is this? 11 kilograms. What does it represent? It represents CT's clothes. Good. How much is this? If that's 11, how

much is left for these two? 18. How much is this one? And this one? And this one? Therefore this one? Nine, nine, nine, and I'll be damned, you just solved the problem. Whoa.

I use that only to give you some sense of how hard this can be, but how powerful it can be. Singapore's bar model gradually infiltrating into new materials. The common core state standards talk about strip diagrams and bar models. They talk about double number lines for helping kids see zero to 100, that's the percent. Zero to \$180, that's the total amount. Discount, it's all done. 75%, what does that correspond to? I set it up; I visualize it. It has been a gigantic missing piece in our curriculum for one simple reason. Far too much of what we've done has been designed by mathematicians who think this way, but don't understand that it's so important, and not by mathematics educators and by teachers.

And so, gang, look at the power of context. On your mark, get set, go. Da da dum dum dum dum dum dum dum dum dum dum. How much? 541, 541, 541. How many of you started to sit there and go, ah! How many reached for pen and pencil? How many of you sat there and wanted to go, ah, can't do, can't do, cross it out [inaudible]. Yeah, you laugh, okay, but in fact in the real world, right, that's sitting there going, and one is -- one is 60. And 40 more, 41 is \$5 and five more. That's called counting on, right?

I can now give you five different ways that people in this room get 541 if we had all the time in the world. I'm in classrooms where we have contests for who can come up with another way, who can justify their way. Ladies and gentlemen, if it isn't clear to you that the one right way to get the one right answer is a mathematics guaranteed to continue to sort kids out. Mathematics, focus on alternative approaches. How did you do it? How did you do it? How did you see it? And celebrating those alternatives is the only way we are going to make a difference in kids' lives. And so play and think about all those different ways.

Here we go. Oh, my god, just can't wait. Oh. Is there a decimal on the outside? Is there? What do I do with it? Every kid is sitting there telling you to shove it, but they are polite. Move it. And if I move that one, then what do I do to the other one? You know, it's like move it too, right? I mean, where's my calculator?

Would you rather be in this class or in this class? Oh. Already I got the same number. Boys and girls, where am I? Good. What's the question? Not today. What's the question? Good. That's not today's question. That's the only question you could possibly have, huh? Oh, because you're all thinking division,

huh? No, how much change do I get if I buy four? Oh cool. No, that's not the question either. Ladies and gentlemen, if we live in a world of data, the question is, so? So?

With your partner, come up with three questions. Only then do I get kids that they're, can I get 10? I'm sitting there going, holy mackerel. Never in a million years would it dawn on me to ask that amazing -- can I buy 10? No, no, no, convince me. Ooh, automatically I never accept no. Convince me I can't get 10.

Let's go. There are two answers in this room. What's one of them? \$15.90. How many \$15.90 nerds are there in this classroom? \$15.90, good, good, good, good. Great, they're all men. It's so perfect, right? All right, can you explain, nerds? What is \$15.90 to us peasants? 10 would be? 10 would cost? Oh, you see, I should have -- obviously one-tenth of 450 didn't sink in. Obviously you don't understand about multiplying and dividing by 10 yet. If they're \$1.59 each, 10 would be? \$15.90. I don't have \$15.90, therefore I can't get 10. The far more normal answer in a real world is they're more than a buck. They're more than a dollar, right? So explain. So if they were all a dollar --

AUDIENCE MEMBER: Then it would cost me \$10.

STEVEN LEINWAND: Then I'd get 10 for \$10. But?

AUDIENCE MEMBER: They're not.

STEVEN LEINWAND: They're not. They're?

AUDIENCE MEMBER: More.

STEVEN LEINWAND: Therefore? Does it not blow your mind that I started with what I thought was a stupid division problem? And by asking so, I'm now doing inverse reasoning. I am using my class to inform their own learning. I know which way I want to go. I know what things I need to pump in. And if I'm teaching this three times during a day in a middle school or high school, I have the previous class' work to use to, again, to put this stuff in.

So can't get 10. How many can I get about? Kids say five. How come? \$2 rounded up, plus there's probably tax. I love it. Right? Kids say six. They say six because \$6 and \$3.60. They say six because six times 16 is 96. They say six because two of them would be -- two of them would be? \$3. Four of them would be? Six of them would be? Oh my god, look at that. And now I'm doing proportional reasoning right before my very eyes and I write that answer down. How interesting. About how many can I get?

Another kid says, well, five is too few, 10 is too many. It must be seven. I love that answer. They are all the kind of answers that will get kids full credit on the test. Oh yeah? So wait a second. You can't get 10. You can get about six. Boys and girls, exactly how many can I get? Now I have to divide or now I have to use a calculator, and now I need to know what button to press. Look at what goes on. Oh no, I don't really have any idea what anyone in this class has learned today.

Exit slip. [inaudible] \$1.29. You found another \$10. You now have \$20. What's the question? How many can they get? Wonderful, show me the answer. You can't walk out of this classroom until you show me how many you can get. And I want to see how and why and all that kind of stuff. The kids go, yeah, this was cool! Neat, Mr. L. I like the way you do that. Right?

And here it is, gang. The way in which we continue to ignore the importance and the power of context. On your mark, get set. Math nerds, go. Oh, I can't -- oh, I'm sorry. Need to press it again. Now. Look at how artfully I've chosen my four-letter variables. This is obscene! I've got the F-word and the S-word and I've got all this cockamamie stuff there and you can't wait to find F [inaudible]. That is mathematics. And in case it isn't obvious to you, that just sucks intelligence out of kids' brains.

And the only question we ought to ask is, when the heck does any normal human being do that? And the answer is that very problem was posed to me five years ago on Interstate 91 in southern Vermont. First I saw the blinking lights. Honest to god. You understand, I'm paying a speeding ticket and I'm sitting there going, this is unbelievable. For \$81 -- no, for \$74, I've got something I'm going to write about and use for the rest of my life. Right, the speeding ticket, \$74, very mild.

Ladies and gentlemen, what is mathematical understanding? What is algebra? It isn't starting with that. Algebra is here is a relationship involving two variables. What are the variables? What are the variables? Speed and? Which depends on which? Define depends upon the speed. Therefore we define the function as a function of speed. It is F of S . It is F equal, right? Four times some speed over 65, right? How fast was I going? 81. What did it cost me? I've already told you. Where did I get 74? Oh. The kids hate that. What's the answer? Where did you get it? Wait a second, where did you get it? Well, I got it by, yeah, plug it in, right?

You understand the reason why I love this problem is Kyle walked into my class the very first day, right? Kyle sits there. I mean, you know, come on, it's either Josh or Kyle. You know, eh, Mr. L. It's Kyle here. You go, yeah, hi, Kyle. I've heard about you. He says, deal. You don't call on me, I won't destroy your class. Kyle, you got a deal, man. Love it. You better not destroy my class. I'm sitting there

doing this and Kyle says, hey, Mr. L, it cost you \$74. I go, Kyle, where did you come from? You see, even Kyle could not keep his mouth shut. And at that point, I go -- I'm lying through my teeth. I got a Z3. You think I'm only going 81 in Vermont on empty roads? I was going 93 that morning. It is unbelievable how much kids now want to evaluate an expression.

And then what is mathematics, gang? What is mathematics but my brother got a \$102 ticket. Ooh, what's the question?

AUDIENCE: How fast was he speeding?

STEVEN LEINWAND: So I ask you, which class do you want to be in? Shut up, sit down, and do it. Shut up, sit down, and do it. Or a class that starts with the seed problems, that starts with the applications, a class that gives kids a reason to care because they are all living in a world of MTV and hip hop and fast-paced stuff and I don't even begin to tell you what goes on.

How is it possible that you think that you can teach kids the same old way when you go home and night and you see that before dinner, your kid is sitting at a computer screen, carrying on five IMs in five different windows, downloading music that would drive me absolutely to distraction, and googling stuff to cut and paste into the social studies paper. You laugh knowingly. You laugh and you say, no wonder they're bored to death.

No wonder I honor the geometry teacher who I watched last month who said, you know the rules. I will take your smartphone away if it's under your desk. On the desk. Daring the kids to IM. Daring them. And then using it as the carrot. You get done early, you can go do your stuff. Now that is if I can't beat them, I'm going to join them. I'm going to set some clear rules that say it is time for us to treat each other -- at a high school. I'm not sure I would pull it quite that way in a middle school.

And so, gang, I have no time to do this or this or this today except that -- perfect. There it is. So what have I done? I've given you a quick and dirty primer on the fact that it's instruction, gang. We understand how important it is and we all have to come together and recognize that it is not the context, it's not McDonalds, it's not the calculators, it's not the collaboration that does anything except give kids a reason to care. Well, that's critical. Most kids don't care. Most kids do not want to come and play at the table.

But you need to understand that the heavy lifting is not McDonalds and calculators and small groups. The heavy lifting is how did you do it, how did you do it? How did you see it? How did you picture it? How does that relate? How does your way work to this? How did you get that answer? It is

the questioning that engages the kids, that is the essence of what we need to attend to when we watch these tapes. In other words, we're talking about math that empowers, not sorts. It's math that relates to students' own experiences. It's based on sense making, not regurgitation. It expects students to find answers to problems and not solutions to problems. I mean, not answers to exercises.

There it is. So you have a summary, ask them why, and those kinds of things. And your handout has these paragraphs that take these things that can be planned, explains what that means. It's emphasis on problem-solving and reasoning. I am not going to read you these slides. I am simply going to say the summary piece is a starting place. Division of effective teaching and learning that we then need to use as a discussion template, we then need to use as a way of analyzing what is happening and what we want to see improve.

And so there's the vision laid out. How do we get there? How do we get there? Gang, once again I remind you, we get there when people are given opportunities to see it, when people have an opportunity to practice it, when people have a chance to collaborate around building this stuff. And so the question is, how do you do that? How do you change the culture in any reasonable kind of way?

And there it is. My curriculum, your curriculum, our professional discussions need to focus laser-like on what is the mathematics we are teaching? What are the objectives? What are the big ideas? How does that fit together? Our lesson plans have got to identify not just the objective, but the big idea and the typical misconceptions. We need to be clear that that's what's going on in this particular lesson. We then need to pick apart the teaching that we conduct and worry about that teaching, the technology and the materials we use to support that.

Come on, gang. There is stuff available on the Internet now that supports lessons and teaching that is unbelievable. There are applets that allow me to show things to kids I never could have done ever before. We need to talk about that. We need to recognize that among every 10 teacher -- 10 teachers, there is one crazy, lifeless nerd. That's the person I depend upon to send me all of those kind of, oh, I tried this! Oh, I found this at two o'clock in the morning. And emailing to everybody. And we sit there and go, oh, thank god for the nerd while I'm breastfeeding the kid, right?

And so we -- in 1971, when I started as a 22-year-old hippie math teacher in the school within a school program of Middletown Connecticut High School, I literally could do it all. And I did. I had a textbook, I had chalk, I had a blackboard, and there was a disgusting, ancient ditto machine in the back of my room. I needed nothing else.

Do you realize today with all the technology and all of the new things in math and all of the expectations, I can't possibly do it all. No one can be the geometry expert and the algebra expert. Nobody can be the statistics guru and also be the person that -- if we don't start to recognize that we need to share and learn, I will simply tell you that in the schools that I've been working in with the General Electric Foundation, when overnight we moved from three third grade teachers, three fourth grade teachers, and three fifth grade teachers to one math third grade teacher, one math fourth grade, and one math fifth grade teacher, the scores increase instantaneously that year. Because we have identified the superstar math teacher. We have reduced that professional load by two-thirds down to three people. They collaborate because they are teaching math and only a little bit of science. And all of a sudden, you recognize that we have ways that we can do that and build on the expertise.

You know that the teachers who are the best math teachers in your elementary schools are often some of the reading teachers, and vice versa. When do we acknowledge that fact that kids are being screwed by the self-contained classroom, certainly after third grade? The curriculum, the learning that we inculcate, did it work? Did we see it and all that stuff? And it's the equity that we foster. That's the curricular -- that's what you and I totally have to do. Good math well taught with good materials so that kids learn and, in fact, we narrow gaps.

How do you do that? Well, I'm not going to bother with the resources except to show you that it costs no money. This is not -- oh no, they cut -- yesterday, the thing I did out at Kansas, right? The whole Skype thing, right? And it's like, well, how do we do all this stuff? There's no money. And I sit there and I go, you don't need money for your curriculum guides. You don't need money for the textbooks. You already have that. It doesn't take any money to have observations. You have free periods. You have the kids go to music and art and you can do it then. You have demonstration classes. How hard is that? You have video. It's like we have all these tools. And I say to you, put them in place and use them.

And then when all is said and done, you say to me, yeah, but. Yeah, but there's not enough time. And I challenge you to be the leader you're supposed to be. I'm in schools that have structured and focused department meetings with an agenda once a week. I'm in schools where the department says, as they just did recently in a school I was in, screw the contract. We meet weekly. Teachers just sit there and go, look, we can't do our jobs any other way.

I'm in schools that have before school breakfast meetings and people rearrange daycare and that's the day their spouse takes the kids to daycare. I'm in schools where the coach says, every other Thursday I've got to be a math teacher. My assistants will take care of the team. Those are learning

communities. I'm in schools where there's beer and pizza sessions outside of the school. Math department meets every single Friday. It's simply part of their behavior and programs and stuff like that, and the principal finds ways to fund some of that.

We're in release times. I'm in schools where the principal hires a substitute and systematically organizes the substitute's day so that Rebecca can go and watch Sabra teach and so that -- that's Randy. So that Randy can come and watch me teach, and then we all meet after school and talk about what we did. How hard is that, right?

I'm in schools where, in fact, the coach and the principal teach classes to free up teachers to be able to do it. Nothing earns a principal better kudos than getting the word, he took my class. She took -- she did -- kids liked her. Right? After school sessions where we do the debrief. Ladies and gentlemen, we have opportunities for the time. And then what do we do?

And so I'm simply going to remind you that the other piece of the handout is we're all in this together and we all have a role to play. Ladies and gentlemen, we are asking students to engage in tasks that promote mathematical thinking. We're asking them to interact with each other. We're asking them to use materials. We're asking them to apply ideas. We're asking them to communicate verbally. Is it clear to you that that cannot happen unless, as it says, their teachers create an environment that lets that happen, that teachers artfully plan, their teachers provide the rich task, their teachers encourage students to find alternative approaches, their teachers use the textbook in artful ways, their teachers collaboratively do stuff together.

Guess what, gang? Teachers can't and won't until and unless principals are knowledgeable about good instruction and knowledgeable about the curriculum, can actually provide support, know what's going on in the school, set clear expectations for what we have, provide the necessary support, monitor daily instruction, ensure that professional development is not a waste of time, use faculty meetings -- in 2012, you know that in a world where every teacher has email, there are principals that are still running faculty meetings on the basis of administrivia. Any faculty meeting that is not about teaching and learning with administrivia done electronically is, to me, incompetence. Using faculty meetings, using student achievement data to build action plans.

And then it says, and how the heck are principals going to do that unless the central office administration and the superintendents, bullet, bullet, bullet, bullet. Ladies and gentlemen, we all have a role to play, and so I leave you with these slides that say classroom visits, demonstration classes.

These things become -- in the best schools I am in, people have common readings. Okay, the work that Anne is now doing with places, every single weekly meeting there is a three-page summary of some of the research or something that relates to what's going on. The connections between the area model and multiplication and the distributive law is what Anne worked with fourth and fifth grade teachers on just this week. It's to what degree are you doing this? Oh, I'm already doing this. I understand. Wait a second, why are we not doing it? How can we begin to build? It's technology lessons.

How many of us know that Jimmy is using this technology artfully, seamlessly in room 204 because Jimmy is 25 years old and has lived with it his whole life? And Sarah is sitting in 206 and we've invested \$10,000 into technology that's gathering dust. And you know what? I don't blame Sarah. I ask when has Sarah seen what Jimmy does? And Sarah says, I've never seen what Jimmy does. And I say, Sarah, come with me. I tell the principal, get this substitute in this room. Sarah and I are watching Jimmy. And Sarah goes, oh my god. And that's the way things begin to change.

We take videos. So gang, I mean, the fact of the matter is if we don't capture it, if we don't have a video of it, it doesn't work. And we have got to become more transparent. We've got to recognize the power of those videos. In all those ways, we got to look at the data and use the data. And so I don't have to read this to you. I simply say to you there is a to-do list of things that leaders need to do, all of which relate back to all that we've been talking about today.

And I just think to remember that it's not a PLC that managers -- by the way, acronyms. When I started teaching, we had talented and gifted programs and we knew that it was talented and gifted kids, and they were programs with talented and gifted kids. By the time I left the classroom, we were tagging kids. What the hell is a tagged kid? We had individualized education programs when I was teaching, and we brought in, you know, 10-90-304. What was it? 90 C something, 94142. Amazing that I can still -- wait, no, no, no, now we just have IEPs and we PPT and all that kind of stuff. Nothing is stupider than taking a professional learning community and bastardizing it as, where's your PLC agenda? Let's do PLCs. What the hell is a PLC?

I'm sorry, we need to demand that we have professional -- [inaudible] it's the content. It's what we do. We interact. It's the follow-up. It's the changes that emerge. It's the professional sharing and interaction that is what makes the difference. And if we don't recognize that the improvement that we are being demanded to make, the common core state standards challenges require us to do things differently. And this whole talk has basically been what is possible, what is doable, and what we have to do.

Okay, your turn. Which of this can't you do? All these things, videos and common things and finding the time, which ones can't you do? And I go back and I start with teachers and I do exactly this. I go, okay, your turn. I want you to tell me why I'm pie in the sky. I want you to tell me I'm this crazy dude from Washington. Which ones can't you do? And we find ways, every one. Every problem you have is an opportunity for us to solve. And the fact of the matter is most of you won't dare raise your hands now because you know that, in fact, there is no excuse for us not to do many of those things. And most of the excuses we have are just so unbelievably hollow.

But how? How do you do these things when you go back to the ranch and you have just a video of this silly thing and the handouts, and you deal with the fear of change? The unwillingness to change because it's so hard. The fear of failure because none of us, kids, teachers, administrators -- how do you deal with the fact that there's no confidence? I don't know enough. Right, that there's not enough time. There's never enough time. That there's not enough leadership? Right, there's not enough support. All the yeah buts. All the yeah buts of what, but, but, but, but, but.

Ladies and gentlemen, in 35 years of doing this, there they are. The only things that I've ever seen that make a difference, the only way that I see a school that really works is people share. They're in it together. People support each other because teachers are smart enough to know that no one else is going to support them. They just aren't. and they have to support each other. Instead, we divide and conquer, and then we wonder why it doesn't work.

And we need to take risks. If it isn't clear to you that everything I've said today involves risk-taking, it involves change, it is uncomfortable, then this has been a waste. And so sharing, sharing I don't want to do. We've talked about all these things today. So this is just a summary that I don't need to do, okay? The mindsets are we're in this together. That is the community spirit. All right, the mindset is we said people can't do what they can't envision. They won't do what they don't understand. And therefore we help each other envision and understand. No one can know it all. We need to differentiate. We need to work as a team. And professional sharing is part of my job. Professional growth and admitting.

There's some amazing stuff written now about coaching and why it is that all musicians and all sports players paid millions and millions of dollars to have coaches. Doctors don't have coaches. Teachers think that coaching is a deficit. The very best teachers want to be coached. We all need to be coached. Coaching is professional growth. It is a core aspect of what it means.

But ladies and gentlemen, when all is said and done, there it is. While nothing ventured, nothing gained is such an apt aphorism for so much of life. Come on. Go for it. Go for it. You miss the tackle, follow up, do it again. You're okay. Right, take a chance. It's okay. Call her. Call her. It's only a date. She won't bite your head off. Plus, I'll still love you. That's what great parents do.

Great teachers, come on, you got that one wrong, but try it again. I know you can do it. Nothing risked, nothing failed. As you well know, right? Nothing risked, nothing failed is a far more powerful way that we operate in school. Don't take a chance. Don't do this. Don't step outside the box. You better not do that until you have tenure. Ridiculous! Look at who we name our schools after. One of the greatest ironies of this business is we have a curriculum and we have posters that honor, there he is, Martin Luther King. And there is Nelson Mandela, right? And there's Galileo. And there's Mahatma Gandhi. And there's Abraham Lincoln. And there's Thomas Jefferson.

God darn it, I'm not asking a single one of you to go to jail for 27 years like Nelson. I'm not asking you to stand on a balcony and get shot like Martin. I'm not asking you to go on hunger strikes like Mahatma. But how is it possible that Galileo and Lincoln and those people that we honor took such risks, and we can't take a few necessary risks to make this world a better place, to better empower the next generation to know some mathematics?

My email address appeared on the first slide. I think that my email address appears on the last slide. There it is. It's back on the first slide. You want the slides because you can't find them? Just email me. You have questions? You know where to find me. I will be careful not to be texting while I drive back to D.C. today, although I don't always honor that either. Ladies and gentlemen, this has been a pleasure. I hope you've gotten something out of this. Go back and make a difference.