DR. RUSSELL GERSTEN: Let me start with a question. How many of you love math in this room? Whoa! Okay, that's always—I always like to ask that because most of us have to keep that to ourselves or people kind of throw you out of the room. And so—at math sessions we could usually kind of enjoy that together.

What I'm going to do is, actually the National Math Panel has ended. There was something in that bio there was a little dated by about four years, but I did serve on the National Math Panel and learned a lot and some of that will be infused here; but I am going focus on RtI. We will have a little break right around the middle and I'll be prompted for that.

I changed the title a teeny bit because I thought this might be a good time and given how sophisticated Pennsylvania is in general in terms of RtII it would be a good time to more candidly look at this research and where we are and what we really know and what are some of things we are grappling with and about. Also to keep things moving, I'm going to focus a lot on the practice guide. I will show you what it looks like, tell you how to download it, they are totally free. It really is I think a good basis for thinking about a district or a school plan for RtI. It covers all the components in the research phase. There are going to be a few things. I know we well, I know we all like to do stuff that's active rather than just sit for two hours, so I have a few brief kind of think/pair/share activities that I've scattered around and we trying it. This is more than we usually do but I think it'll work out well and give you a chance to digest instead of just scanning slides.

We are going to talk about what a practice guide is and the levels of evidence, the research thing base because it is good despite our goals and aspirations. It's always good to know what the facts are and what are the things that we're really going out on a limb, especially because some of those things even though distinguished professors from various universities strongly believe in them or like them there is not necessarily a factual basis there, which allows us in the schools to experiment with perhaps more creative more sophisticated ways of doing things.

The background on RtI is going to be minimal, you know, because I think this is a state with a relatively long history. I'm gonna probably focus the most on what to teach, because that was a thing we worked on the hardest both with the panel and with National Math Panel. For a second if you just want to pick someone who'll kind of be your partner for the think/pair/share stuff and if it works out probably the person next. But again that way, at least across the table, that kind of thing. Yeah, okay. This is only a two-hour commitment it's not major thing. Okay, okay.

This is what a practice guide looks like, the cover. You'll have a chance to do stuff soon now you just know who you're gonna work with. This is the cover of the practice guide and it is downloadable. It's in the material that you downloaded, your handout material and if for some reason if you don't have it if you just Google through IES, you Google IES you will find Institute of Education Sciences and they will say practice guides and you can download which ever ones you want. There is an RtI Reading and an RtI Math both of which panels I share, chaired rather. They consist of recommendations and the recommendation is almost like a plan for a school or a district. They're eight of them and I'll show them to you in a second. Then we talk some about how to carry them out and it was panel mixed with practitioners and researchers and we did what we could and just shared some of our ideas. We are really clear about the level of evidence that supports it using really rigorous standards.

As many of you have heard of in the last eight years, the Department of Ed has decided that rigor in research is really, really important. It decided that partly because Congress said that so much education research was weak compared to other fields that they were thinking of just cutting out funding unless there was something radically different done. And so there has been radical changes in the quality of research and how we evaluate research and that's the standards we used, and we also talk about some of the roadblocks that some of them may even resonate that we've gone through or others have gone through as you try to implement change in terms of RtII.

In terms of the evidence we go—we only looked at experiments not at qualitative studies but we did look at the predictive studies for measures, which is less of an issue here but when you get in an area like English learners there is some concern about that; but the ideas that the more case study kind of things, which you will read about in RtII. If—you—those are interesting. They shed light on things. You can get insights about things but they are not hard evidence that this is gonna help kids or teachers. We rate the evidence as strong, moderate and low. They're changing low to minimal but you'll see some things that seem to make a lot of sense. There simply is no evidence to date. If you think that many of us read the numerous health medical kinds of things about does this pill work, does this such and such, you know, if this food good or not so good for lowering cholesterol, and many times you'll just see them saying it hasn't been studied yet. So that's really what low evidence means. It just hasn't been systematically studied yet and sometimes people cannot figure out exactly how to do that well.

This is kind of what a page looks like. Their recommendations and the roadblocks, and this seems to go at lightning pace for some reason, but that's probably unreadable in a room this size; but it is those various things. It says here's a recommendation, how do you do it and what are possible roadblocks and what are some possible solutions to them.

This is a group of the panel members and that's Sybilla Beckman who is a mathematician, and those of you who are interested in working with colleagues or even upgrading your own knowledge of math of the math that underlies elementary and middle school courses it's an excellent book; but the fourth edition I think just came out or is just coming out; but she really probably does a better job than anyone in explaining the math that underlies what we're teaching and as many of you have heard from La Ping Ma (sp) or Deborah Bole (sp) or Heather Hill or numerous others many American teachers are not strong in the math vena. The mathematical ideas and concepts that underlie what you're teaching in arithmetic or fractions, and that book is a great possible tool for building that and Ben Clark and Ann Fagan have both done some work in Pennsylvania and both are strong in the assessment realm. Ben is little kids and Ann is more middle school, high school and upper elementary. Laurel Marsh was our practitioner, she is a math coach, and John Starr is the Harvard professor. We had to defer to him.

Question? It's Sybilla Beckman's book.

AUDIENCE MEMBER: I don't know that it is out, states that her new addition is out, I can't remember the title but if you Google her name it will pop right up. It is a beautiful book it has butterflies on it. It is just as fairly knew __9:57___ mentions that.

DR. RUSSELL GERSTEN: Yeah and I think that it's turquoise, not that that helps. I think it's Math for Elementary Educators.

AUDIENCE MEMBER: It is pretty basic.

DR. RUSSELL GERSTEN: Yeah, the title, but it's just Beckman. Yeah. I think I actually might have the site for the older one listed in these materials too. Then Brad Whitsell does a lot of work with more high school and middle school kids. We kind of—we tried to cover the spectrum.

One thing we tried to do here, and it is really important, one of the things that we know about change and some of us keep hearing the buzz word, Michael Tholen was one of the earliest people to articulate that is what people want in an innovation and change is some sense of coherence. How do these things fit together, so it's not just a laundry list of suggestions or research findings and that is something that we—we really worked as best we could to what this represents about teaching, at least a framework. One huge challenge, and all of you know this at some level, and that the amount of research in math is dramatically less than in reading so we had less to go with. Luckily we had a lot more to go with in 2008 than we would've in 2003 let alone 1993 because people have really begun to do rigorous research in teaching math, though we still get a lot of opinion pieces and opinions and case studies, but at least that's what we're starting to do.

I think in this state I'm just going to put this on for two seconds, the famous inverted triangle, which I'm sure now every master student or under graduate, is like going Yuck, I never want to see it again. Other than these numbers here—the, you know, 5% at any given point in time might need some Tier III support about 20 odd percent Tier II. These really are not based on hard data. People are still trying to figure this out. The 5% comes a little bit from some of the work that cognitive psychologists have done about trying to figure out the real nature of math disabilities, which is really the kinds of students who really, organizing abstract information is real hard for them, so that's where the 5% comes as an ideal. So the theory is these are kids who are just going to need Tier III because things related to storing abstract information, the meaning of mathematical concepts or in some cases both, just are really hard for them. So that number is probably about 5% where other kids just need additional support, so the theory goes; but these numbers are not hard and fast.

First think/pair/share. Take a look. These are our eight recommendations, and I'm going to put them back on the screen in a second, but what I'd like you to do is not just look at them because cruising through a list usually gets a little tedious. Just think about which level of evidence surprises you the most and chat. So just go through these. Which of the eight things, which we'll discuss, is the most surprising in terms of the level of evidence? We'll take maybe a few minutes to talk, to think about it a second and then talk to your partner and then we can hear what folks have to say.

Okay, okay folks. Let's kind of debrief and see what we came up with. First—any volunteer from any group about what was surprising, no right or wrong answer to this obviously. Somebody?

AUDIENCE MEMBER: Number 2.

DR. RUSSELL GERSTEN: It’s a surprise that there is no low evidence. Okay. Because there's, well tell me why it was surprising for a sec.

AUDIENCE MEMBER: 14:43

DR. RUSSELL GERSTEN: Yeah, okay, okay. Oh okay, the reason was because that's a focus of a lot of our instruction. Yeah. And remember low evidence doesn't mean we think it's a bad idea. We think it's a good idea but we couldn't locate any evidence, and that is one that is closest to my heart but we have to stick with the facts here. I'll talk a little about the evidence in that in a few minutes.

Yeah.

AUDIENCE MEMBER: _15:16___and the reason that I think number 2 is because when you look at, you know, countries around the world and number 1 in math, for instance Singapore, they start off in kindergarten doing fractions and _____ you know that whole thing. Yet we teach whole numbers. The teachers here were saying that ______ they don’t know _____ one and a half till they hit third grade. So ____ you know we have looked at ____ compared to, you know, nations that are ____ on math and are ________.

DR. RUSSELL GERSTEN: Yeah, that. I'll tell you at the National Math Panel that came up a lot and this is the problem, and I'm sure all of you have had some course in research somewhere along the line. When you compare things as they exist, so you're not doing an experiment the problem is a lot of things are different between Singapore and the U.S. and then you look at other high performing countries. The Czech Republic is one and there are quite a few in Asia but there's also one of the Scandinavian countries and Flemish Belgium. They wind up doing things very differently. So there are so many things that are different about them, everything from class size in many of these places is larger than ours to the amount of math teachers know in most of those countries is higher to the ways of teaching. In some it is very didactic and some of the Asian countries it is very didactic and much more drill type stuff than we have.

In others it's much more exploratory. It's more like one of those programs like investigations. So it's hard to pinpoint. Also then there's a country like France that is excellent at focusing on whole and rational number but the achievement levels are not particularly good. So we can't say there's clean evidence of that. It seems a good direction to go in and there is a researcher, Bill Schmitt, who some of you maybe know the name because he's been doing the TIMSS and looking at it this way, that way, sideways, who actually worked on a study where he compared a curriculum that did this, focused on whole number, rational number, relationships between the two and how they link to geometry. How—rather than treating geometry in measurement as separate topics you go in and out of you use numbers so much, measuring obviously relates to number line, areas to multiplication, etc. and those results we hope will be out soon. I've been hearing about it for two years, so then we'll have a little bit of hard evidence, which maybe could nudge it into moderate. So that is—that's why this science idea is there.

Any other surprises? Tracy.

TRACY: The one that Al and I talked about was number six. ____18:49__ basic ____.

DR. RUSSELL GERSTEN: Were you surprised it was so low or high?

TRACY: I thought that—I guess ____ because it's such a basic part—foundational part, most classroom ___ teaching in multiplication ____ kids to ---city with multiplication facts that to actually find that it is just kind of moderate because it is such a large part of third and forth grade.

DR. RUSSELL GERSTEN: It was just the number of rigorous studies we could locate. The other thing about this, because we're talking about interventions, you know Tier II and Tier III, is even when kids are in the seventh grade there are quite a few who sat through third and fourth grade and maybe practice multiplication facts but you ask them 9 x 3 and they're you know. And my the--, so one of the quick hallmarks of a student with let's say difficulties in math, a kid who needs intervention in middle school or fifth grade, is weak math facts. They just go hand in glove, that is they correlate again and again. Now it doesn't mean that's all the student needs but you do need to work on it, and we only found moderate results, moderate because there just weren't enough studies, but we, also a concern is there are some math curriculums some of you may have run into where quick retrieval of facts is like aah, it'll come. Where, you know, you'll see day after day kids can do it mentally or they can use their fingers or they can could some manipulative and let them do it whichever way and you'll just see that in the teachers edition and in the directions to students. So that doesn't seem so good because that's probably contributing to the problem. Because I've always felt that you know if the student, we forget if the student doesn't know that 9 x 3 is 27 as well as they know how to spell their name or whatever then the tendency is to get lost and to not understand the math lesson, because if you're doing very simple pre-algebra the teacher assumes, the peers assume if it's 9X equals 27 and you divide both sides by 9 they are not following what's going on.

The idea in interventions to consider this component everyday we felt very strongly about and we hope maybe in a couple of years we'll be able to go to high evidence because we just need, I think we just need one more good study.

Yeah.

AUDIENCE MEMBER: 21:59 Well number sever, I thought was a ______ given that the logic of it is about the __________ mind.

DR. RUSSELL GERSTEN: For Tier I students they have, yes, for Tier I students. We looked very carefully at the evidence for Tier II and III, which is our main focus here, because to do all of tier I is just—It's overwhelming, it's everything in math. For Tier II and Tier III students we could find no evidence that it was helpful. In fact, what we found, and I've been looking at some of these case studies of RtI in high school almost always what people use is not the measures that Lynn Fuchs or Ed Shapiro or others talk about to monitor progress, they use measures that have been around at least since the 1970s. They use what I call curriculum imbedded tests. Some programs have daily little checkouts and often once a week there's sort of a quiz of what's been covered that week. Some call them unit tests; but people typically use those in interventions.

Now the panel still thought it was a good idea to use this system, maybe not exactly like the Fuchs system but some progress monitoring that looks at the totality like a fourth grade curriculum for a couple of reasons; but one of the main reasons is you want a sense for students how the combination of Tier I instruction, Tier II and in some cases Tier III is doing, is this whole thing that our elementary or middle school is offering say are leading to growth in math. So if you do just your weekly test in your catch up program or whatever, your support program, that isn't getting at this whole totality. So that's a reason we thought monthly measures would be good, even every other week, but it really at this stage is more of an opinion and it just seems in the very small groups, and the Fuchs work was different, it was in the whole class Tier I. In a small group of three to five kids people tend to want to just assess how they're doing, you know, how they're doing in the material you're teaching them. So we recommended it but we didn't find evidence.

Do we have time for one more surprise, cause it's kind of an interesting way to approach this, but those would tend to be the biggies I think that surprise people, the facts less likely just cause I don't know why, less likely. So and motivation sometimes surprises people. This is the thing we could not find any study that looked only a motivational system. Many of them had it as a component with pencils for young kids or stickers or all kinds of things, they had, or sometimes self-monitoring stuff; but they always were bundled or packaged together, so for that reason we had to say at this point in time there's no evidence. The National Math Panel said there is evidence but when we looked they kind of played fast and loose. They included the package stuff and also they included stuff from science and other areas, so we were more by the book, so we stuck there.

Okay, so that is the heart of what we found and I think there's probably no shock, so that's more the level of evidence. Though to us those seem to eight real pillars or key components of math RtI based on what we know now.

Screening unlike progress monitoring we got a moderate for and to be more specific K2 or especially K1 and one it was good, it was strong, there were just a lot of studies showing they're these quick measures you could give kids and they'll give you a sense of who needs help, who's likely to at least you know benefit or you know from a little bit maybe just 50 minutes a day of support. Grades three and up it was really limited. There was one study by Lynn Fuchs and her colleagues, little pockets of things. It's not been well developed yet how to screen. People with the younger grades have often gone the direction of the DIBELS and that seems in K and one to be okay, and I'll show you some examples in a second. You may be familiar with them some of you.

But in the upper grades how to do a quick screen is more something and my belief is the State of Pennsylvania is—has something under development; but it is not clear. A hunch I have, we didn't really discuss this much with the panel, because by the time we got through all this evidence there was a little bit of exhaustion there, is some of these computer assisted with a locator test is probably the way to screen and I think with measures like that there's only one study so far on the RtI center web site, which again is—will be in your list of resources; but basically that is probably the way to go rather than something like an oral reading fluency. Ann Fagen just says that in some ways in math there's never been anything like oral reading fluency that at least grades two to five is consistently a correlate of reading, a quick way in a minute or so even though they are three minutes of reading almost when you take the middle passage it winds up being the same passage for about 90% of kids in most cases, the oral reading fluency; but there's nothing like that in math.

Let's look a little at K2. The content of measures, usually it's one aspect of number sense and often what we do like the DIBELS or Ames Web is you know assess a few aspects. I always like to go for being a little bit more lean and mean. Also it can get really confusing when you have four numbers for a kid. The two that seem the most important are strategic counting, which I'll show you at least a quick example, and magnitude comparison. Robbie Case who passed away now about 10 years ago, but he was a brilliant cognitive psychologist who looked a lot at young children and talked so much about how a lot of your growth in math is a development of an ever more sophisticated mental number line and more recently Bob Ziegler has looked at that that when kids are like six or seven and you ask them to put numbers on a number line its kind of, 80 and 20 are as close together as maybe 4 and 8. You know, it's kind of garbled. They kind of know maybe the area of 1 to 10, maybe up to 15 or 19 and it gets increasingly more sophisticated and that's where you were talking about how 1½, a lot of kids you give them 1½ or 2¼ and you don't know where they're going to put it. They could put it right next to the 3 or something like that. So sophistication of the mental number line is a key thing, and magnitude comparison quickly gets at it. Those two seem to be the two keys for young kids, K and 1 especially. Grade 2 and up I think what we're going to see a lot of is things linked to the common core standards and things like that that just quickly give you a sense using sophisticated statistics, so it will be a very different world than the world that many of us are used to from beginning reading.

These are just examples of what Ben Clark calls a missing number measure, which is, I call it strategic counting just because, it's just not asking kids to count and seeing how far they can get, which teachers have been doing for a long time and continue to do. This kind of task like the top one, what, twenty, twenty-one. You gotta really be flexible with your counting and have a sense of that, you know to just know that, or to know—you know to again be able to retrieve that quickly and the other—again knowing the number in the middle, what's between 8 and 10, you have to be able to quickly start counting up from 8, which as we know is one of the first strategies that kids learn in math, you know the counting on or counting up strategy, so that these measures seem to predict pretty well that .6, .65 for young kids and magnitude comparison, and these seem easy to us but a lot of kids they get lost like 79 and 95, 7 and 9 are BIG numbers so that must be a lot bigger, you know, so they kind of, you know it's a good quick way to separate kids, young kids, who have a good sense of number and are getting more and more proficient with the mental number line and counting strategically. Those would be to me the two ways to go with young kids.

Yeah.

AUDIENCE MEMBER SPEAKING: 33:33 __________

DR. RUSSELL GERSTEN: Do we have. . . You know, I don't believe yet there are norms for these measures. I know, well I know Ames Web has versions. In fact, they have something that is adapted from Ben Clark's study but I don't think they have norms.

AUDIENCE MEMBER: They do have norms.

T DR. RUSSELL GERSTEN: They do now? Yeah, yeah. Well that would make sense you know now because they're with that big Pearson Publishing, and we're actually working on a study as we speak that where it wouldn't be national norms but it would—It's really going to look at how these measures predict scores on a nationally standardized test and we'll see how that comes out; but the—right now the tests are still being scored, the Tarenova's, so umm, yeah, but they're, so that's good to know. They're imperfect but they seem okay in the scheme of things.

We'll have another think/pair/share in a second. These are the kind of roadblocks we came up with, something to be aware of because it comes up a lot that in kindergarten and to some extent in the first grade you get a lot of what we call false positives. You get kids who come, you know, whose scores look like they're in the yellow or even red zone that they need help and yet if they're left alone just with regular classroom instruction, being around numbers and counting and doing the various activities and being taught math they do fine. It's a huge problem in kindergarten. The factor is probably as high as half. In other words like if in your school 32 kids it looks like they need help, probably 16 really do.

Does anyone just have some possible ideas why this may happen and just—this would just be speculation at this stage? You know the, I mean the basic sense, and this was verified and we did a study, I won't mention the city. One city in the four we were doing had, they get some classes, and these were first grades, 80% of the kids would be classified at risk, and we would then go to much poorer districts and there would be nothing like that, it might 30, led us to believe that they didn't, in this district, they didn't teach any math in kindergarten. Because why else 80% of the kids are not knowing which number is bigger 11 or 9, 8 or 5, counting. I think that is a huge factor in both K and one. Preschool and child care centers vary a lot. Some kids come from homes where numbers, you know older sister/mom loves doing number games, practicing stuff with numbers, board games, and others not. And there is a big push now, and one Secretary Duncan is pushing heavily to really do math in preschool, daycare, Head Start. It can be fun stuff and all but to just make sure kids have it; but right now there are some kids that just—It's almost like they're math deprived. They just haven't been around numbers much. Whether or not they need an intervention, the problem if you put all of your resources into K and one there are a lot of kids who need help in fourth grade, fifth grade and elementary schools, so that is a huge issue.

Why don't we try this one, which does come up quite a bit. That the screening might identify a large number of kids who need support and it's well beyond what a school could provide. There was this school principal who met with us and she had like 20 of the 28 fifth graders came out like they needed help in math. Maybe if you just go into your pairs and just think about what you would do when you get this kind of thing happening, especially if it's classroom after classroom.

Okay, let's kind of wrap this up okay. So let's hear a couple of solutions to this pretty formidable problem, assuming you have a valid screening measure. Somebody? Yeah.

AUDIENCE MEMBER: 39:02 There is something wrong with the core programs. If you had a large numbers there's something missing from the core that's not being identified or being addressed.

We need to look and see. When you say large numbers that _____ it's core if you have a___ like that. You gotta find some kind of supplementary program or somebody who ________ .

DR. RUSSELL GERSTEN: Yeah, that would make sense to me. It also would seem that if this was happening in fifth grade you'd want to really look at grades three and four because they're entering fifth grade and possibly even do some deeper, you know, get some more comprehensive data on what are the areas that kids are weak even if it's looking at the state tests or something cause something is missing. Because there actually was a case where the principal set up Tier II instruction with a small group of 18 out in the hallway, which would make more sense that your core instruction right, and maybe you could differentiate it so the kids who are fine, you know the kids who still don't know what a fraction is, get a supplement in their core and the other kids can be doing some more advanced work with someone. Yeah, and that will happen in math depending on the school and all. You will see that in the upper grades on certain key topics.

Any other thoughts about what you might do? Yeah.

AUDIENCE MEMBER: 40:47 I think from the ______ altering what we do _____screening _____ screening what the kids can do.

DR. RUSSELL GERSTEN: Yeah, yeah. Absolutely. I've really, you know not totally trust the publisher, I would maybe work with your evaluation first and just see how the screening scores relate to that one year's state test. Does it predict pretty well, whatever. Yeah. Yeah. The third thing is I probably would still want to get support to some of the kids who are really at the low end. You know a small group of kids. Because even this additional, you know, bolstering work is going to take awhile to kick in and you might have kids who are three years below grade level. So if you have kids who are still struggling with whole number operations you still want to give them some support too. But this will happen in certain schools and certainly in certain middle schools as well. I think what ideally might happen too is as we develop this new generation of screening tests you could then, you know, the ideal is then they'd feed into a more, a longer diagnostic test for the kids that are having problems, so you could really get the topics across grade levels, the foundational topics that they don't know. But that is—It's a vision but I think it's doable given what we know and given the fact that fact that in a lot of ways math tests are a lot easier to develop than reading comprehension tests, vocabulary tests.

The rest of what we're going to talk about is, and we'll still have a couple more interactive things, is what, kind of what and how to teach Tier II and Tier III. Now is a lot of this relevant to Tier I? The answer is yes but we're focusing here on Tier II and Tier III, that's where our evidence base was. What we did in terms of what to teach is we could find no data. We definitely were aware of the international studies and some of the ambiguities there, but the basic idea, we looked at what the National Math Panel said and we said the same should be true for interventions. That in your intervention your Tier II or Tier III were, or your various cascades, what you want to do is make sure kids know whole number and rational number.

Now certainly geometry and measurement are important. It isn't so important to follow lock step current or current state standards and cover a little probability a little this a little that. It's more important that kids become proficient with whole and rational number and in many ways this is consensus of MCTM. It is not what MCTM was saying in 1989 but that was a different century, a different era. The International comparison suggests that the common core standards suggest that, and we think it's even more important than interventions to do that, so that kids really hone in and become increasingly proficient with numbers. Now this is a different, and this is something to look at, as you look at or adapt an intervention curriculum is the program needs to include these three things. Procedures, and the concepts and ideas and the word problems. It doesn't, so if all it does is computation with the idea with some word problems once every seven days and kind of en mass, it is not a good curriculum for a student receiving an intervention.

Looking at Singapore, which someone mentioned earlier, once you see it you never kind of want to go back. They mix computation, word problems and for younger kids' picture, and still for older kid's picture problems, they just go back and forth. That's what a lesson is like, because they all involve the same ideas, the same mathematical ideas and concepts. What happens is if you have 20 straight computation problems it's kind of boring; but similarly if you have 20 straight word problems it's kind of bore. So you're doing two things. You're making the activities for kids more interesting and also you're helping them gain insight to what the various operations mean, what division means because then they may have something involving splitting treats among five kids and so you have a word problem and then you go back to it you might even having something involving area depending on the age level; but the idea of integrating all of them is a move that I hope intervention curriculum move to that because what you want to do is bolster kids and get students are going to be very hesitant to explain their thinking, explain why they did things. You want them to do that, and this is one way to do it if they are integrated together its easier because you're kind of living in that world as opposed to just discrete tasks. That's not the only thing; and the other part of it is really an integral link to the properties of—basically of—specially of addition and multiplication that you want to integrate the two together. I've seen books where they do number properties, that's one lesson and then you're back to standard algorithmic formulas. The idea is you keep going back to it and kids see, so they basically come away becoming proficient in computation and really knowing the distributive, associative and communicative laws as if there were—the back of their hand, which is the way to build a foundation for success in algebra according to mathematicians. Now, of course, they developed this logically not empirically.

One think I'm hoping with the State of Florida, they've been moving ever so slowly, is to see whether when you look at the kids score on the algebra tests they have taken eighth or ninth grade and how they did in fourth grade. We could start to look at patterns and see whether competence with fractions predicts as well as mathematicians think it will and with number properties. The other thing that we want to do, and we want to look for an intervention program, even more carefully is that the definitions are precise and accurate. Now this comes from Sybilla Beckman's book, so this is the second edition, so now it's the third, the turquoise one. It's called Math for Elementary Teachers. It's not the most captivating title, although they make up with it with the art work. What?

AUDIENCE MEMBER: It is a beautiful book.

DR. RUSSELL GERSTEN: But the cover edition. Yeah, the second edition had Zebras—Zebras and Magenta. This one I guess is turquoise and—

AUDIENCE MEMBER: Butterflies.

DR. RUSSELL GERSTEN: yeah, and butterflies.

But basically, when you teach kids, what we've typically done in this country is you teach kids fractions are part of a whole and you do all of this stuff with the pizza pies and the cakes and who knows what; and then suddenly one day you say okay we're going to do improper fractions, so 7/4ths is a fraction. They're going, wait a minute. You lied to me. Why are you telling me its part of a whole, now 7/4ths. Then you'll always get this nice problem. There are eight pencils and Mark took 3/4 of the pencils. How many did he take? Well what's the whole? Eight pencils is a whole? What? What does that have to do with pizza pie, birthday cake, you know swimming. Oops, that just means it's getting close to break time. Okay, so that—which is a good, great break point. If you'll notice in Sybilla Beckman's definition there, it is mathematically accurate and kind of explains more what, so it's breaking, it's breaking one or more, you know it's breaking things into parts. And what I would do with fractions and especially with intervention kids who are going have a lot of hazy ideas of things if you're covering foundational stuff is give them the array of examples, so it could be 2/3 of the houses in the neighborhood. It could be 5/4 of a cup of water and they'll see that. I mean, it's very easy if you're making oatmeal or something like that. It'll say for two 1¼ cups and that kind of thing. And then giving, not kids just keep word hints but saying we all use the word of very often when we deal with fractions and you notice the way she frames it here. Now the dilemma we have is how to cover this material in a way that children who might be nine or ten or twelve understand it.

Okay, in a second we're going to start video. I just want to a do a little bit of a set up. See this sheet is on your table. Video Reflection Form. And it is the top one we are going to focus on. One thing as you saw in the practice guide, we talk about teaching explicitly. Which one problem with that term is everybody defines it differently be it in math and reading and whatever. But we tried to use much of the language of the National Math Panel to talk about instruction that is explicit in terms of—and one thing that keeps being stressed, clear accurate definitions are not mentioned only once by a teacher but they are reinforced by a teacher when students come up with a phrasing. The teacher either, you know, commends it for, you know, being right on the nail or further elaborates if a student can really give a sense of what a ratio is. And the other part which seems critical in both math and in reading in the areas of comprehension in particular is thinking aloud. So what this tape is is an example of a math teacher doing some thinking aloud and trying to implement what I was talking about earlier, linking procedures with the mathematical concepts and ideas. So this is about six or seven minutes or so. Yeah—yeah. So we'll take a look and jot down your notes.

VIDEO: So I have also seen a problem like this one set up in a different way. In stead of being set up horizontal or side to side, sometimes I see someone set the problem up in a vertical way like this. And I am wondering why would someone choose to make the problem vertical instead of horizontal and do partial sums like we have been doing. One thing I noticed is that in this problem, the numbers are in columns. So I noticed that the ones are in the same column and the 10s are in the same column and the 100s are in the same column.

When I see ones together and tens together and 100s together it makes me think about place value in our place value blocks. So I know that if I was to show this problem using place value blocks it would look like this. There are seven ones, four 10s and three 100s and I have six ones, eight 10s and two 100s. So if I was going to group—going to group my—these 10 blocks together, I know that when I add seven ones and six ones together that would give me 13 ones and I can record that. The same thing would be over here with just using numbers instead of my pictures. And if I was to add my 10 blocks together I would have eight 10s and four more 10s, which would be 12 tens. Over here eight 10s sand four 10s is the same as twelve 10s, and if I were to add my 100s together I would have five 100s blocks and that would be five 100s over here. But I'm looking at that number and I've never seen a number recorded like that before, 5, 12 and 13. So I'm thinking that there must be something else that we need to do.

When I look at my base 10 blocks I know that when I see 10 single blocks or 10 one blocks that I can make those a group and once I put my 10 one blocks together that's the same as a 10 and that one 10 can be recorded over here in my 10s column. So now instead of having 13 ones I have three ones and now I have 5, 10, 13 groups of 10. But when I look at my 10s column I see I have 10, 13 groups of 10 and I know that if I put 10 groups of 10 or 10 10s together that's the same as 100. So I can put that 100 over here. Now instead of having thirteen 10s I am left with three 10s, instead of having 600—or 500s I'm now left with 600s. Altogether I have six 100s, three 10s and three ones and that's the same as 633, which gives me the same answer that got with our partial sums of 633.

So we know that this was a good strategy because we got the same answer here that we got with our partial sums of 633; but that seemed like there was a lot of crossing out and changing to do and I'm sure that there must be a more efficient and faster way to solve this problem without having to do all that crossing out. So if we look at our problem again and we start with the ones. I know that seven ones plus six ones is 13 ones, and I know that 13 ones is the same as one 10 and three ones. So I'm going to record my three ones in the ones column and I'm going to put my 10 with the other 10s and now I'm going to see how many 10s I have. I have eight 10s and four 10s and one 10, and eight 10s and four 10s and one 10 would make thirteen 10s. I know that thirteen 10s is the same as 100 because when I put ten 10s together that makes 100 and then I have three 10s. so now I'm going to record my 10s and I have three 10s and I'm going to put my 100 over here with the other 100s, I'm going to keep those together. Now I have 100, 300 and 200s, which would be the same as 600s and I get the same answer if 633.

DR. RUSSELL GERSTEN: So—what would be good is if you jot a few things down and then in your pairs just talk a little bit about this example of explicit instruction involving explaining reasoning, thinking aloud and with the understanding you don't know all the context but reactions to it would be of interest I think. Okay, okay. How about if we talk about what we saw as perceived strengths and weakness, potential weaknesses in what you saw. Somebody want to start this off? Yeah?

AUDIENCE MEMBER: 61:30 -----strengths is that showing all extensions _____ representation as for procedures_____ so that they understand the connection between ____ ten blocks how they're tied together. ______. _______________

MALE DR. RUSSELL GERSTEN: Yeah, I think that's a definite strength and it's intentionally done and if we had been looking at math lessons from another earlier year we would rarely see something like this. Do you have a weakness from your group? Or we can—

AUDIENCE MEMBER: 62:26___ about that—the fact that the children didn't really do any discovering, the teacher gave them everything. I thought that was ________

DR. RUSSELL GERSTEN: Yah, I think that is a definite weakness. I think we were all maybe finding the concept solid but it was getting a little tedious because you just tend to zone out a little bit. Now, I'm not sure –there's—whether the children had to be doing discovering but they had to participate because what happens by actively participate, you kind of develop insights into the math, you know. Yeah?

AUDIENCE MEMBER: What grade was that?

DR. RUSSELL GERSTEN: You know, I don't know for sure. I mean it really comes to us without any great anchors and whether it was a Tier II group or Tier I group, yah? Comment?

AUDIENCE MEMBER: 63:37______, I mean, nobody ever taught me any of that stuff. You know, unfortunately I teach at the upper levels, but what they did there I thought would be really interesting for young people to understand that there's three or four different ways to think about the same thing. And once you can do that then you can get it easy. I thought that was kind of neat there.

DR. RUSSELL GERSTEN: Yeah, no that was an absolute strength and clearly these were systems she had built with the instructional group and she was linking them pretty clearly. Yeah?

AUDIENCE MEMBER: Well, she was clearly showing them multiple ___ and anybody who teaches elementary math knows that many of the ______programs are exclusively teaching ____________. What I'm seeing happening with kids that meet Tier II and Tier III intervention is that teacher are assuming that the multiple algorithms will confuse the kids and so they are choosing most of the time a more traditional algorithm and explicitly teaching that at the expense of the two, or the other three, or four exposures of _____ So I was wondering what your thoughts were on that and I'm thinking there are teachers who are going to read ____ explicit and in hearing that we are going to say that means I take out all the discovery learning and I am just going to teach them ________. 64:55

DR. RUSSELL GERSTEN: And as this gentleman pointed out, to give you a hint as to my thinking, that way you're depriving these children of really future success in algebra, geometry, where you have to think about multiple ways to strategize about solving a problem. You can't, you know, and you're also depriving them of what that standard algorithm means and she did block that out very clearly. That would be really unfortunate so I feel that if that that is not the way to do a Tier II or Tier III intervention. What you do perhaps want to do more with some of your intervention students, you know the way it terminated in the standard algorithm with this little, you know, hint that this one is a little more efficient to do, but what I would do is keep going back to the others, but make sure some of your kids who are not very quick and fluent with facts and with all this stuff get a lot of practice with the standard algorithm, but not omit that other material because that is where the concepts and ideas are and ultimately the idea of, there area often several ways, and sometimes one way is just more efficient. Yeah?

AUDIENCE MEMBER: I'm thinking too from the standpoint of parents helping their children. A process like this is very beneficial because parents will often say to me, "well I learned it a different way. I'm afraid I'll confuse my child." This way at least the children are getting to see multiple presentations and parents can then help.

DR. RUSSELL GERSTEN: Absolutely, yeah, and this is the kind of thing even if the parent didn't learn it that way, if the parent knows how to add and subtract they can kind of get the gist of this you would think and understand it…..yeah? Yeah. From the back.

AUDIENCE MEMBER: 67:23 ________________. 68:03 One other think I was wondering if the teacher ________________.

DR. RUSSELL GERSTEN: Yeah. I would agree with, Yeah—that was an imper—I would agree. The two points are; one –it wasn't necessarily the best possible demonstration of everything, it had a coherent system for linking, having it interactive with kids playing a role, as you point out does two things; kids often use words, it's easier for them to think of words that their age mates, you know, understand better and the teacher can always, if they are a little off, kind of, you know, just kind of guide it and it would have made it more interesting too as opposed to in the old days you have one kid get up on the board and do the whole thing and what I don't even know is whether some of this was done to help the videographer, but that is—yeah—that is an example though of the—you know both explicit instruction and perhaps we've come up with ways, it could be refined and still definitely be called explicit instruction. Yeah?

AUDIENCE MEMBER: To follow your logic about the multiple strategies and long term affects but is there a level of evidence about multiple strategies or a single strategy—

DR. RUSSELL GERSTEN: Funny you ask because we're working now on a practice guide dealing with problem solving, so it's not dealing with at risk learners per se, it's dealing with the whole gamete of learners and it goes up a little bit even more in the age span and there's—I think we—that one came out in the moderate area, so there was some evidence of it being, you know, of it being promising. The thing is though what this lesson did was gave some closure that they're all related to each other, but it's not really anything goes, there's going to be a time where you don't want to get out your 100 "U" blocks and your 10s blocks and it gave a nice sense of closure and I think we've all seen these activities that just kind of end and drift, so kids had a sense that they're linked together and she did mention it being kind of slow to do it this way. So, but there is a little bit of evidence here, but we're still—but I'm giving—I'm leaking, it hasn't gone through peer review and this and that, but it seems like we were able to find some and they work with somewhat older students. So, because I think your point about how it sets the stage for what you're going to be doing in middle school and secondary math is exactly right, where you're abstracting out and intentionally switching.

So, evidence we've found for explicit instruction was strong. When I looked at the actual studies; now these are the studies with the at risk learners and we used those with certified special ed. students with IEPs in math because you can't kind of retrofit, in 1996 there wasn't any RtI in math, but there were kids who needed help and did that, but when we linked them all together the real themes that came out were extensive practice with feedback and this is a key for your Tier II and Tier III interventions that all of the systems, some were scripted, some just had, you know, basically a more global idea of framework like this, but what made them all successful was there was—the kids had extensive practice so you didn't move on, I mean you didn't make it laborious, but you didn't move on until the kids really were becoming pretty fluent with doing it. Not necessarily automatic, but they were fluent with it because you need the procedural facility too to really grasp the ideas and feel comfortable with them. The other thing that kept coming out is exactly the point we heard from the back letting kids provide rationales for their decisions. And this can be initially an uphill battle with some of your intervention students because too many of them math is something they want to get over with. Get it out of the way. Then, maybe have a teacher come by or an assistant come by and help them with a few problems and say, "let me show you how to do it" and then they do a few. So, the idea that setting this stage in your intervention where often you have the small, three kids, four kids, five kids, that tell me either your reason for doing this again and again, so if kids just race through it and all, at some point you're building that system that you need to stop and think of a reason, if you don't know it, working with peers and other things, but the idea that you need a reason for doing things. There were a lot of models of proficient problem solving. Some came from fellow students, some from teachers, some this mixed approach, but that—those have seen the cornerstones of explicit instruction, based on really the themes and the actual studies. This is just your classic case, just a quick example here of what many kids will do is they'll put two-fifths down for whatever reason, it's the easiest thing to do, they, you know, are used to multiplying and in multiplying you do the easy stuff and what you need to do, rather than just say, "no, this is wrong, do lowest common denominator", is do this is one possible thing to do where you're really slowing them down so that they understand it where they're really working with these sort of strip diagram kind of things or a whole array of things. They could be visual representations or concrete objects, but the whole idea is they're doing it a lot more slowly, but they're getting a sense of using this so that they do as many problems this way rather than just rushing into the straight computation and trying to get it over with than just being nagged or reprimanded. So, this is the kind of thing that should happen a lot. We already did the tape, so that was my prompt to do the tape.

The amount of practice necessary for students in Tier II and Tier III may be underestimated by some of the programs that are linked to core series. Now, I'm not talking about ones that just do very traditional 1958 math with tons of drill and all, but they may not do enough and if so, when that is a possible roadblock, and sometimes people just for all kinds of reasons do the intervention using the core text, maybe they go back six months or even to a year ago, but if that's the case, you just need more. There could be guide books for school staff that a math specialist, the curriculum department, some mix of special ed and math put together to just provide additional examples so that people can give kids adequate practice. Now the practice doesn't have to be mass, just practicing multi-digit addition up to the 100s column, doesn't—you could do that and you can do some other things. They don't need 18 examples of exactly the same thing, but the idea of practicing a lot and getting feedback and talking about decisions. Word problems is one of these few victories. It's where we actually found, you see the evidence is strong a lot of studies and many of these were done, they all were done with students either called low achieving or called special ed in that era, but the basic idea, and some of this comes from the cognitive psychologist Jim Greeno and then the work on cognitively guided instruction. It was adapted and made more systematic.

Basically, a step was added on, rather than just going addition problems and subtraction problems or proportion problems, for addition subtraction, this middle step was added in which is, is it a compare problem is a word—and I use the adult word, does it deal with quantities or is it dealing with change over time? You know, these words have a history to them, compare and change, but in some ways I would push kids to use the more abstract words because those are the words they'll be using for the next 10 years in science classes and in the more advanced math classes. So, you basically add on, rather than just saying which operation do you do, if you have a problem? You have to classify what kind of problem it is. What this forces kids to do is, some kids are rusty with facts and don't deal well in the abstract level so you separate out the tasks and they actually can do little card games with it so that you have some word problems and they are just telling you, so they don't have to solve it yet, some will get lost in the computation, they're just telling you, is this a change—is this a change problem? Is there some quantity or something that's increasing or decreasing? Or I would say is it something changing over time? Is it changing over time? Getting bigger? Getting smaller? Getting higher? Shrinking? That kind of thing.

A group problem is where you just pool things together and make them a big group and technically you're combining two sets and compare problems is you're comparing quantities, which is bigger? Which is smaller? How much bigger? How much smaller? So, kids are, what you're doing is you're building their mathematical language skills, and the same thing you would explicitly model it quickly as a teacher and have them practice with each other and give you reasons and initially the reasoning will probably be garbled, but if you could get them on the right track of talking abstractly about change over time correctly, you've done a massive amount for building the foundations of basic problem solving, word problem skills and this is one, they're not killers for adults, but maybe as a--just a change of pace to do these, think/pair/share, these three problems about whether they're a change over time, whether you're comparing magnitudes or whether you're grouping stuff together. So, do you want to just partner up, or do them yourself and share them with a buddy for a few minutes?

Oh great. Oh thanks. I can move for a second. Oh that is a jumbo? Great. Thanks. Okay. I will call down to the room during the break. Yeah, okay great.

Okay, should we see how we did with them? Somebody want to volunteer for number one? Whether we're comparing quantities, changing over time, or grouping things in to a larger set? Yeah?

AUDIENCE MEMBER: Comparing.

DR. RUSSELL GERSTEN: Comparing, yeah. We're comparing quantities, yeah, even though it's two different kids and it doesn't happen at exactly the same time, we're comparing quantities. Yep. Number two. Yep.

AUDIENCE MEMBER: Group.

DR. RUSSELL GERSTEN: Group, yep. We're making a big group, even though it's an odd thing to think about and would be for kids, we're taking these planets that are quite far apart and we're making a big group of the rings way out there. And, number three?

Somebody else want to try number three? Yeah?

AUDIENCE MEMBER: Change.

DR. RUSSELL GERSTEN: Change. Yeah. Change over time. So, you can see where for third graders or so this would be kind of a challenging activity but a way to really get them into this more abstract mathematical way of looking at things, oops, okay. And that is telling me we've got about another minute, and here's just a visual that goes with it because that's probably one of the last themes using visual representations which we saw in the tape.

You can see, because then you can flip them different ways, sometimes you know how many are in the end but you don't know how many ducks, you know, you don't know how many ducks so you have to find out how many ducks swam over so kids are also developing a nice sense of the meaning of inverse operations. So, this has been quite an exciting line of research, in fact, Asha Ditendra is one of the key researchers who was at Lee High for many years and with that I guess-since we only have about 45 seconds left, I think for questions you can come up here and I just want to thank you for being engaged and participating.