DR. DYLAN WILIAM: I worked out of the bayou you heard it is about 5 years old, so I thought I would do my own. I started out teaching because I was working in a rock band, and I moved to London to be a rock star, and I was playing bass in a band, and we needed some money for a public address system. I had a big bass amplifier, but nobody could hear the vocalists so we had to buy some public address equipment and so I started teaching and in those days back in England in the 1970s there was such a shortage of math and science teachers that if you had a degree, with a major in math or physics, you could just walk into a job. So, I applied; I sort of walked up to the school and I just said I am a math teacher and they said come in. That was a Friday. The following Monday I started at the same time as a social studies teacher who lasted until morning recess and walked off the site, the building site, and was never seen again. So who knows what happened. And so, I taught in city schools in London and then I trained teachers and did a number of personal development projects. I was at ETS from 2003 to 2006 trying to get them interested in the idea of promoting learning as well as just measuring it and that kind of came to an end. I built them professional development materials, which they settled for, for 2 years and so I built my own. I am currently University Provost and I am going to stop doing that in September, because I have decided that universities are not where it is that anymore; certainly in terms of teaching. I think that the most exciting thing is happening in schools and so my current project, I am going to talk about this all later on, so I am just going to give you some brief outline of what I think is really exciting me at the moment. And that is the idea, it has to do with activating students as early as they are learning, but with training students as videographers. So the idea is that we train students to produce videos of classroom teaching from the learner's perspective that the teachers and the students can then sit down together and watch and talk about how the teacher might do a better job of meeting the students' needs and so we have had a number of technical problems like how to get decent sound in classrooms and so we train teams of three students, so you have a director, a camera operator, and a sound engineer, and the idea is that they video classrooms and then they share the products with the teachers. So that is what I am quite excited about at the moment is that there are number of schools that are really exploring making students genuinely participants in their own learning. I think it is very exciting. So, that is what is getting me excited at the moment.

What I am going to talk about today, however, is trying to make some connections between AFL and RTI and the difficulty is that RTI (Response to Intervention) is used in a number of ways by different people, but at its simplest RTI, to me, connotes an approach where you teach kids stuff and then you work out if they are doing okay and if they are not, you teach them in a slightly different way. It is more intensively and if that works for them then that is fine. If it is not, you give an even more intensive approach. This idea of tapering the intensity, if you like, to the need of the student. So the idea is that you have tier 1, tier 2, and tier 3 type of instructions. Are you familiar with it? Yep. Well, for me, that is just a special kind of formative assessment or assessment for learning, because the whole idea about RTI is that it is actually saying we teach kids to read or to do math and then we will see if they are doing okay and if they are doing okay, we will carry on with the same stuff, but if they are not doing okay, then we will do something different with those kids. So, the idea of

RTI is exactly within this idea of formative assessment. The idea that you find out where kids are and then you adjust your instruction to better meet their needs. So that the pyramid approach to RTI is just one particular way of doing it and it is quite a bureaucratic approach. It is quite a long, I call it a slow burn approach, because it is about teaching kids and then having kids out in a group and maybe being given individual instruction and it is about…it is measured in weeks. Where as what I am interested in is actually improving the quality of pedagogy, improving the quality of teaching over a time scale of minutes and hours rather than weeks and months, so that we need fewer kids going into tier 2 and tier 3 interventions. So what I am saying is that the approach that we got for reading is actually at all bad, but it's based on that monthly or weekly cycle and that's okay, but what I'm interested in is the minute by minute and day by day cycles of RTI (Response to Intervention), which I call formative assessment and that's the stuff that seems to make the biggest difference. So, RTI seems to me to be not designed to improve instruction. It is designed to improve outcomes, so it is basically saying we are not going to improve the teaching or reading we are just going to treat all of the kids the same as we always have done and some kids will be fine with that and other kids won't. So for the kids that are not okay with that we give them more of an intensive intervention and for kids who aren't okay with that will give them even more intensive intervention, but it does not seem to be designed to improve the kind of reading instruction kids are getting, just getting a more expensive version or a more powerful dose of the drug, if you like. What I am saying is, we can do better than that. We can actually improve the quality of the reading instruction that all kids get. And the crucial thing in all of this is this idea of effective learning environments. Now, as I said earlier, there's the old joke that schools are places where children go to watch teachers work and when I go into schools I see teachers working too hard and I see students not working hard enough and then so the question I always have when I look at any classroom is who is doing the intellectual heavy lifting here or is it the teacher or is it the students? And too often it is the teacher. So, the misconception here is that teachers can create learning. Teachers can't create learning. Only learners can create learning. Imagine trying to teach somebody to play the guitar by demonstrating. The only way to learn to play the guitar is to learn to play the guitar yourself and have somebody helping you do that better. So at one extreme you got the prevalent mistake in view, which is the teacher's job is to create learning. The teacher's job is to do the learning for the learner. At the other extreme, you have the teachers who use the "F" word - facilitate. I don't teach this, aye. I just "facilitate" learning. To which I say, "So what are we paying you for" "You were just hanging around waiting for some learning to happen?" The best teachers have always realized that while you can't do the learning for the learner, you nevertheless have a responsibility to create an effective learning environment. So if you can't do the learning for the learner, but you can take some responsibility in designing learning that will maximize the chance of that learner doing the learning that they need to do. I call that the engineering of effective learning environments. And I like that term "engineering" because it implies a creative as well as a scientific basis. The technology versus physics relationship is interesting here. If you want to build a bridge you have to know about that tensile and compressive strength of steel and stone and, but knowing all of that stuff doesn't tell you what the bridge should look like, but it does tell you that this bridge design won't work, because you have stone intention and

stone does not behave very sensibly under tension and if you have a tension member you need to buy the wood or steel. So, knowing the physics helps you avoid mistakes, but it doesn't tell you how to design the bridge and in the same way, known as psychology, helps you avoid some pitfalls in terms of the design of learning by the students, but it never tells you what to do.

It seems to me that the two main features of effective learning environments are that they create student engagement. So, I call those pedagogies of engagement and that they are designed to keep the learning going in the direction that it is meant to be going. So that you find when kids are not learning what you want them to be learning, you find that out quite quickly. I call that, pedagogies of contingency. The psychological jargon is that you regulate the learning of the student, so that the idea that you actually keep the learning going in that direction that it's meant to be going.

So why pedagogies of engagement? Well, this is not only a fashionable view these days, but it is scientifically correct. That is that a substantial proportion of intelligence is inherited. The inherited component of intelligence is not 0, but so what. Until we have gene therapies that will change kids' intelligence we do not need to worry about that. What's interesting is that intelligence is partly environmental and we are beginning to discover how strong in affect that is. So, we know that the environment creates intelligence or affects it. The scariest stance I think I've ever heard, is that a kid at the age of 22 months in a working-class household, but in the top 10% of cognitive development, is overtaken by the age of 7 by a middle-class kid who started at the bottom 10% of cognitive development and it was due to the environments that those kids experienced. Nobody is entirely clear why, but one interesting explanation comes from the work of Hart & Risley, who published a very important study in 1995 called meaningful differences and what they showed by videoing an hour at random of parent-child interactions in households in the United States was they showed by the age of 36 months a kid in a professional household, will have spoken to the adults 25 million more words than a kid in a family on welfare. It was 50 million as against 40 million words spoken by adults. So, we know that environment creates intelligence.

Recently we have also begun to understand that intelligence creates environment. I don't know if you have read Malcolm Gladwell's book, Outliers, but in it he talks about the Medicine Hat Tigers, which is a junior ice hockey team in Canada. There is a total roster of 25 players, so almost all of the players were 16, 17, 18, or 19, but you can actually have some 15 year olds and some 20 year olds, but most of the players are between 16 and 19, with a total roster of 25. In the book, he publishes a table with various stats on these people and asks, "What do you notice?" And nobody ever notices the most important thing, which is the dates of birth. Here are the dates of birth of the 2003 Medicine Hat Tigers. What is it? Why are there so many January births? Is there something special about conception in late spring that makes you more likely to give birth to an ice hockey player? Spend a minute on your tables discussing why you think so many of these players are born in the first quarter of the year. Any ideas about why so many of these players are born in January?

AUDIENCE MEMBER: - _____

DR. DYLAN WILLIAM: - Interesting, interesting, yes now. I don't think that's right and I don't think were even gonna go there actually. Yeah.

AUDIENCE MEMBER: - You may have sign-ups for sports usually I think at a certain age.

DR. DYLAN WILLIAM: - Right.

AUDIENCE MEMBER: - And I guess that would be that age, that age group, that would be the oldest of that age group so they take the best players…(indiscernible).

DR. DYLAN WILLIAM: - Yeah but, but yes, so the sports year starts in January, but why even by the time these kids are 19 and 20 would that affect still be so strong.

AUDIENCE MEMBER: - _____

DR. DYLAN WILLIAM: - It's like a what?

AUDIENCE MEMBER: - _____

DR. DYLAN WILLIAM: - Yes. Say a bit more.

AUDIENCE MEMBER: - The rich get richer, the poor get poorer.

DR. DYLAN WILLIAM: - Yeah, the rich get richer and the poor get poorer. Yeah. What Gladwell found out was that, you see, when they are 8 or 9 and just beginning to play in these junior, in these children's leagues, the kids born in January, because they are the oldest in the year group, they are just a little bit bigger and a little bit stronger on average, so they get more coaching. They get on the main team. They get more coaching. They get more ice time and therefore, it magnifies the differences. I mean, the whole Outlies book is about this principle. Why did the Beatles get so good? Well, most of the groups were playing about 2 or 3 hours a night and they were playing 8-hour sets every night in these strip clubs in Hamburg. So they just did lots and lots of practice. Bill Gates had more practice on using mainframe computers than, as a high school kid, than most university students got. So, Gladwell's point is that you have people with exceptional talent, but also then getting exceptional development of that talent, because they find themselves in an exceptional environment and so that's the point here.

Environment creates intelligence and intelligence creates environment. Ability creates environment, so the environment creates the ability, but then the ability then creates the environment in turn, so you get this kind of positive feedback loop. And so the question is, "How do we do that in our classrooms?"

Now, the work of _____ 14:20 is quite important here. He's at the University of Chicago and he's basically turned on its head the way of thinking about motivation, because typically, as a result of individual differences in psychology, our view of motivation is very often almost like a needle on a dial in a kid's brain, you know, some kids have a lot of this and some kids not very much of this. We talk about kids being well motivated and not well motivated.

My wife and I fostered teenagers for many years and one kid, we fostered John, he came to us when he was 12 and didn't get rid of them until he was 29, but he came to us when he was 12 and one of the things that the teacher said was he can't concentration for more than 10 minutes and we bought him some Lego blocks and one Saturday afternoon he sat at the kitchen table and spent 2 hours building something and we realized that he didn't have a problem with concentration, on things that he enjoyed doing, he had a problem concentrating on things he didn't like doing, which he didn't find very conducive and this guy _____ 15:19 pointed out, when you have high challenge and low competence you get anxiety, because you're being stressed about the fact you can't do stuff. If you're high competence and low challenge you get relaxation or even boredom, because what you're being asked to do it so easy, but when you get the match between challenge and capability right you get what he calls "flow" and what he means by "flow" is optimal experience; you know this sense of just being completely absorbed in something. Joe Montana talked about not even being awake in a football game or not even aware of it, because you're so much into the game. In the book, that _____15:52 wrote in 1992. He talks about a belly dancer just being completely absorbed in the dance. A chess player talks about how he is so absorbed in the game that even if the roof fell in as long as a bit did not actually hit him he probably wouldn't even notice.

My wife and I both did computer programming back in the 80s and I don't know if you had the same experience as me, but you know, I've said to my wife, "I'll be done in 10 minutes," and I knew it wasn't 10 minutes, I thought it was 20 and she said, "Where were you, you been gone 2 hours?" That sense of being completely lost in an activity is what happens when you get the match between challenge and competence right, that sense of flow. And what that does then is completely relocates the motivation problem, because previously for many years we've said we can't blame the victim; you know these kids aren't succeeding because they're not motivated. Now, of course, it's all your fault. So, basically it's your fault, because you can't motivate these kids.

Interestingly now, what this does is to say that motivation is not cause its a consequence of getting a match between challenge and capability right. So, it locates the problem not in the teacher, not in the student, but in the interaction between the two. I think levels of interaction are very interesting. You notice that the coach, John Wooden, died last week I think, and I can't remember how many titles he's won, but its like 13 consecutive titles, an amazing coach. Somebody asked him what was his secret? And he said, "Listen." He used to listen to his athletes, because without hearing from them he could not help them become as good as they could be and that

notion that this really inspirational coach was primarily a coach because he listened to students and athletes, rather than telling them what to do, which I thought was very interesting. The other quote that I love from him is, “If you don't have time to do it right, when will you have time to do it over?” I thought this was a very nice line for kids you know.

So pedagogies of engagement then we have to engage the learners more and we have to get the kids thinking more in the classroom and why pedagogies of contingency? Well, we know that assessment serves a number of purposes, but we can use assessments to monitor learning. We can use assessments to find out what is not being learned, but even that's not enough. What we have to do is to find out what to do about it. So, the key insight here is that we don't actually know what to do unless we collect the right information in the first place. And so, people don't often enough in my view appreciate that response to intervention needs the right kind of data collection in the beginning to give you the right kinds of followup action and I'll say more about that in a minute.

The other important point in terms of RTI (Response to Intervention) is it's not chaos, but the kinds of learning that the kids will do is not random; it's probably predictable, even though we cannot predict exactly what they will learn. So, the key insight here in the second half of the 20th century is this idea of what's been called a cognitive revolution. Up until about 1950, people’s standard view of learning was associationism; you had stimuli and responses; you have chains of stimuli and responses and when kids learn stuff they were connecting up these chains and if they didn't learn something it means that these links between stimuli and responses weren't strong enough. So what do you do, you reinforce them. I find it quite interesting that most teachers although they say they don't believe in that, when kids can't do something, what's the teachers response? “More practice.” So, often teachers behave like associations.

What we discovered in the second half of the 20th century was that students’ errors are not random. It's not a matter of all students being wrong in completely novel ways. Students are usually getting things wrong in completely predictable ways. So, my conclusion on this is that teaching is interesting, because kids are so different, but it's only possible, cause they are so similar. I am quite interested in exploring the possibility of the group. What could we do better for the group? I think it's a particularly important thing time to be doing that at the moment, because of this focus on differentiated instruction. Now, of course differentiated instruction is policy in many districts these days and it's a very, very popular term. I'm still not sure what it means. Because, we don't have the resources for really truly differentiated instruction, so what do we mean by that? And I look at countries that perform really well on these international league tables and not one of them believes in differentiated instruction. Finland, Japan, South Korea, Singapore, you know we have the saying, “The squeaky wheel gets the grease?” The Japanese have a saying, “The protruding nail gets hammered into place.” Japanese teachers have a real problem with differentiated instruction and you just try explaining that to a Japanese teacher and I mean the one

who speaks English obviously. They say things like, “I'm sorry I don't understand, are you telling me that you are deliberately trying to make this the range of achievement within the class as large as it can be?” “Why would you want to do that? Wouldn't you want to keep… isn't it the teachers job to keep the class together?” And I thought, and it is quite interesting what kinds of approaches they use, because in fact their pedagogy is quite sophisticated. So for example, you go to your American middle school math classroom and where the kids are learning the area of a trapezoid and start a technique that teaches the rule on the board, does one worked example, and then the kids do them in their seats. The teacher walks up and down the isles intervening as necessary with individuals. Japanese teachers approach typically, the teacher introduces one method on the board, groups of students then have to come up with as many conceptually distinct ways of finding the area of a trapezoid. There are 13. No American teacher I know knows that, because they only teach one method, but what's interesting about the Japanese approach is that it is a very inclusive approach. Kids are working in groups and the idea is that if you can actually come up with some of the more difficult-to-find ones, you should do so, but everybody has their own way into this. So differentiated instruction I think needs to be unpacked a little bit. I'm very happy that different students should be allowed different routes into the same material, but I'm very worried about the idea that we have different goals for some students then for others and I'm aware that's a very pragmatic approach that people need to take, but I am aware that the countries with really high performing educational systems try to get everybody up to the highest possible level. They don't try and track people into vocational or other kinds of tracks. Countries that do that, tend to have quite poorly performing systems.

So, I said earlier that if an assessment functions formatively to the extent that evidence about student achievement is interpreted and used to make decisions about the next steps in instruction that are likely to do better or better founded than the decisions that would be taken in the absence of evidence. Now that seems to me a perfectly appropriate definition of what you're doing in RTI. The idea is, that you have assessments that function to make decisions about what to do next. So do we carry on doing the same thing with this kid or will you put them in a smaller group to get more intensive instruction and to do that you do an assessment and the assessment must be basically based on that. So it seems to me, that these territories are very, very similar, but I'm interested in a whole range of cycle times from minutes to years where RTI seems to be focused on a particular sort of weekly-to-monthly cycle length.

> Now, in most cases the weak link in almost all of this is bringing the right data home. Finding the right data. So what I want to do now is to give you some practical activities of questions, some which are better than others, for finding out where kids are in their learning. So the starting point is this math question here, which is, I think, pretty self-explanatory. So, what I'm going to do now is to give you a couple of minutes to discuss this on your tables and then I'm going to ask you to vote which is the best rule to describe the sequence, okay? So, two minutes, which of those four rules is the best way to describe that sequence 3, 7,

11, 15, and 19. Okay, thanks, so can you now about please one finger for A, two for B, three for C, four for D, and vote now. Okay, thank you.

AUDIENCE MEMBER: - I don't teach math.

DR. DYLAN WILLIAM: - I know. That's why I'm picking on you, okay so you chose A. I'm sorry, you chose A.

AUDIENCE MEMBER: - I chose A, because from my recollection of algebra N stands for the number that you have and that's how you figure it out, so that I know the rule is going to be +4.

DR. DYLAN WILLIAM: - talk me through how that would work.

AUDIENCE MEMBER: - I take the last, if I'm looking for the next number in the sequence, but it only works if I'm looking for the next number in the sequence. It doesn't work if I'm looking for number 50.

DR. DYLAN WILLIAM: - That's okay, just talk me through the steps, how does it work? Start with 3.

AUDIENCE MEMBER: - 3, N stands for 3, and to get the next number in the sequence it would be 3+4 or N+4, so then do the same thing for 7.

DR. DYLAN WILLIAM: - So, 7+4.

AUDIENCE MEMBER: - 7+4.

DR. DYLAN WILLIAM: - Okay, thank you, okay. Now you went for A as well didn't you?

AUDIENCE MEMBER: - I did. I did, but I'm not real sure actually.

DR. DYLAN WILLIAM: - Do you agree with what she said about A?

AUDIENCE MEMBER: - I agree with what she said works, yes.

DR. DYLAN WILLIAM: - Now, you went for C.

AUDIENCE MEMBER: - I did.

DR. DYLAN WILLIAM: - Why did you go for C?

AUDIENCE MEMBER: - well, first of all I thought if the answer were A and if it were that simple you wouldn't have used it as an example, so I had to think outside of the box and I am working under the assumption that the letter N stands for the ordinal

position of the number, so for the number 3, N would be 1 for the number 7, N would be 2, for the number 11 N would be 3, because that is the position it is in the sequence, so 4x3 is 12, I'm sorry, yeah. 4x1 is 4-1 is 3, so number 7 is the second number so 4x2 is 8-1 is 7, 11 is the third number, so 4x3 is 12-1 is 11.

AUDIENCE MEMBER: - But how did you know that N was the ordinal number? There is nothing out there that tells me that.

DR. DYLAN WILLIAM: - What do you think of her rule?

AUDIENCE MEMBER: - It makes sense. It completely makes sense.

DR. DYLAN WILLIAM: - So, first of all, do you see how, as a governor of pedagogy, you can actually use these kinds of techniques to hold a more interesting classroom discussion, because I went to the A's first. If I picked by random somebody who everybody in the class knew was going to get the right answer everybody else would just say, “Yeah whatever she said.” So, it enables you to have a more structured discussion. Now, what is interesting about this is that A is the rule that is chosen by a lot of kids and a lot of elementary school teachers, because it's a low overhead, in no basically I get it, yeah keep adding four; it makes sense. The point is, it's a good rule, because it's not very difficult to get your head around, but unfortunately if you want to find the hundredth term you have to find the previous 99 first. What's the hundredth term in the sequence?

AUDIENCE MEMBER: -_____

DR. DYLAN WILLIAM: - So, basically rule C is much harder to get your head around, but it's a more powerful rule, so there’s a trade-off. One simple to get your head around, but actually to find the hundredth term you have to find the previous 99 first, C takes you straight to it.

AUDIENCE MEMBER: - but you have to say N can't be 0.

DR. DYLAN WILLIAM: - you might want to say that, I'm actually, the point is I'm saying is what rule describes the sequence and so yes you could add those conditions.

AUDIENCE MEMBER: - If N is 0 it wouldn't work, no.

DR. DYLAN WILLIAM: - If N is 0 it wouldn't work, no. It would not start in the right place; it still would be the same sequence.

Some people would argue that stylistically were taking care of that based on the number N, because conventionally N is used for whole positive integers. We use numbers like X if you wanted to use something that wasn't going to be a whole number, so, there are all sorts of things that we could discuss.

The reason I like this question is because in mathematics, professional mathematicians talk about the most important thing for them in mathematics is the elegance; I don't see much elegance in middle school math and this question allows you to introduce elegance, because C and D are both correct. You see C, as you put it out, is basically based on the realization that these numbers here are one less than the 4 times table, 4, 8, 12, 16, 20. So, you got to get that particular term in the 4 times table and then you take off 1. The other way to look at this is these are 3 larger than the numbers in the 4 times table, but starting at 0 rather than 4. So basically, you're saying the hundredth term here you put in as 99. Now, that's correct, but it's not as elegant is it? Isn't it much neater to have the hundredth term sticking N as 100 in there rather than having to remember to stick in 99. So, D is an example of a rule that is correct, but not as elegant as C. So I think it is quite a nice thing to discuss with middle schoolers.

But here's the point, I learned that nothing about the quality of your thinking by hearing which answer you chosen. I had to hear your reasons and that means we have to have a lot of time to hear from everybody's responses. Teachers always say to me, “I would get every kid to explain their answer,” and you know what, no one ever does, because by the time we've heard from 20 kids everyone is losing the will to live in most classrooms.

So the only point of having this question is to spend 20 or 25 minutes on the discussion. It's a great discussion question, but it's lousy as a quick check for if the kids have understood something or not. Compare it to this question here. Now, this is a question about Pythagoras rule. Now you may not care about Pythagoras rule, but if I'm your math teacher I care whether you get this or not and what’s sneaky about this question is that there are 2 correct answers. In which of these right triangles is A squared plus B squared equals C squared well it's B and D. Now, if you have been teaching this and every kid holds up B and D with their letter cards, congratulations, they get it, move on. The trouble with too many teachers is they cannot take yes for an answer they keep on teaching something after the kids have got it, so sure some of the time checking in on the kids’ understanding will slow you down; sometimes it will speed you up, because you realize they already understood something you're about to try to teach them. Because there are 2 correct answers here that are 64 possible responses, one of which is correct, and that means the kids’ chances of guessing it correctly just by chance is 1 in 64, which means if everybody gets it correct, they're either cheating or they get it. So, you should move on.

Okay, science. Another example for you for science. Okay, same drill two minutes, okay thanks, so vote now please. A, one finger. B, two fingers, three for C and four for D. Vote now please. There is an interesting corner over here. No, no, no, no he is not. In my classroom you don't get to choose who the spokesperson is. Weren’t you paying attention when I talk about pedagogies of engagement and choosing students at random. Go on, you can hardly be surprised. You wanted more information. What did you want to know?

AUDIENCE MEMBER: - For example, if a glass of water is sitting outside and it's raining.

DR. DYLAN WILLIAM: - It's not. Okay.

AUDIENCE MEMBER: - The answer, okay.

DR. DYLAN WILLIAM: - Okay, fine. Anything else you need to know?

AUDIENCE MEMBER: - Are we needing a board?

DR. DYLAN WILLIAM: - Nope.

Okay, so, you see in most classrooms voting for D would be a way of avoiding making a commitment wouldn't it? In my classroom, you just draw attention to yourself. So, in fact this is a very deep and subtle question, because all of these answers could be correct depending upon the assumptions you make. So, the physics teacher thinks that B is the correct answer, they're deluded, but the physics teacher thinks that B is the correct answer, because of Archimedes principle and here is the best way that I can explain it. Imagine there is no ice here okay, just water. Now, are you all happy to agree that water floats in water? Right? Okay, got it. Now, imagine that you could freeze a block of water at the surface just instantly flash freeze it, it expands by about 10% and that's what water does when it freezes. None of the other water has moved. So the water level is still the same and then when it thaws it just goes back to where it was and nothing else has been changed. So Archimedes principle says that basically the level of water is unchanged. And I thought that was true, because when I was teaching physics until I had a kid in my class who was smarter than I was who patiently pointed out to me, he said, “Why did you put ice in the thing sir?” And I said, “To cool things down.” He said, “yes, precisely.” And what happens when you cool things down? They contract, unless the water has been 0 and 4°C in which case it expands, because water, if you cool down water down to 4°C it will contract, but from 4 to 0 and it actually expands and then freezes and I also didn't tell you the ice cubes were floating. If you have so many of them piled in there like scotch on the rocks then the water level would actually rise as it melted and I did not tell you about the saturation of the atmosphere, so evaporation might have been a significant consideration as might precipitation, raining, it might be raining on that side.

So, this is a great question to have a discussion around. But again, I learned nothing about the quality of your scientific thinking by hearing which choices you've made; I had to hear your reasons. So this kind of question should only be used if you can have 20 minutes for the discussion. It is no use as a quick check on the student's understanding. Contrasted to this one here from Mark Wilson's team at UC Berkeley. The ball sitting on the table is not moving, because A no forces are pushing or pulling on the ball. That is the standard misconception that many kids have. No movement means no force. B, gravity is pulling down, but the table is in the way, Hmmm, gravity is pulling down? Yep. The table is in the way… yep. So what's wrong with that? C, the

table pushes up with the same force that gravity pulls down, that's always seemed very unlikely to me. When I was a kid and heard about this, this idea that the table pushes up with the same force that, I just thought, I'm sure it must be possible to kind of sneak up on the table. And yank the ball away suddenly and if the table was really pushing up then it would go like this wouldn't it? So when I came to teach this I actually used to use a laser pointer in a stand pointing at a mirror on the table and then bounced to the opposite wall and then we put a book on the table, you could actually see the table deflect, because the point on the opposite wall moves down a little bit, because of the deflection on the table. So the answer to the problem is that the table doesn't push up until it's pushed down, so the table pushes back as soon as it's pushed down and that's the reason.

So C is obviously is what the science teacher is looking for. D, gravity is holding it onto the table. Hmmm, that also seems pretty good. E, of course, is strange, there is a force inside the ball keeping it from running off the table.

I see every day in classroom teachers asking questions like, "Where is the verb in the sentence?" And you get what I call kind of catechistic teaching where children go along mouthing along with the rest of the class. So usually you have 6 or 7 kids who are actually giving the correct answer and the rest of the class miming along looking like they're engaged and so the teacher is getting very poor quality information about who gets it and who doesn't, but when you are acquiring every single kid to respond by holding up a letter, you know whether they are all getting this or not. If you're doing punctuation, very simple example, "It's important that the cat eats its food." Even more flexibly, is you can do this kind of question without the multiple choice pre-prepared format, you just write a sentence on the board and then ask the students to contribute punctuation to it. Now in the traditional classroom what the teacher would say is, "Everybody okay with that?" And move on. In my classroom, the rule is. "Is that now correct?" "Yes or no?" And you see how that very small difference creates a huge difference in the kids know, because there is no place to hide, because if you say it's correct when there is still an error there, they don't get it? And if they say they're still an error in there they know you are going to ask them come to the front and to correct the error. So it's that very small difference about getting the students engaged and you see how these two main themes of engagement and contingency keep on coming back. I'm trying to set up situations in which the students are engaged so I get information from every single student and I'm using that to judge the pace of my instruction in real time.

The high order example from the English-language arts comes from some teachers in Cherry Hill New Jersey. This was very much in their minds, they're trying to teach kids what a thesis statement looks like in a piece of persuasive writing and so they came up with this multiple choice question, "Which of these is the best thesis statement?" And I think most, I mean all of these are statements of opinions, but I think most language arts teachers would agree that D, "The amount of violence on TV should be reduced" is the best thesis statement within the genre of persuasive writing, even though it's also true that some programs are more violent than others might be a point of view.

The language, the response that drives language arts teachers crazy is of course B. The essay I'm going to write is about violence on TV. And if every kid votes for B, then you do probably need to teach this again, but slower and louder, but the point is, that you hope that everybody gets D and you move on. Okay. A history example.

AUDIENCE MEMBER: - _____

DR. DYLAN WILLIAM: - Take a minute and then we'll vote. Okay. I'll show you another drill by now. One finger for A, two for B, three for C, four for D and five for E and vote now please. You're just inviting attention aren't you? Okay, thanks. Come on I want to hear what you've got to say, come on then.

AUDIENCE MEMBER: - It's dependent upon your perspective. World War I ends in 19. Some say the treaty of Versailles was the cause of World War II.

DR. DYLAN WILLIAM: - It was.

AUDIENCE MEMBER: - So we could say that it started World War II. In 38 Germany invades Poland, so for the Poles it started in 38, but America started in 41 with the bombing of Pearl Harbor. So, it depends on your perspective of when the war started.

DR. DYLAN WILLIAM: - Yes, I agree, but I want you to choose one perspective and then stick with it.

AUDIENCE MEMBER: - Then, in 1941, were in America; it's the United States…

DR. DYLAN WILLIAM: - yeah, it's really interesting. The previous group, nobody went for 41 and I said, “Are you just being nice to me because I'm a Brit?” But it's curious actually because when I'm in Britain I talk about the fact that many Americans go for 1941 and the Britains say, “Yeah, of course, the Americans arrived late for that one as well,” but then I point out that we get very annoyed with you a lot when you talk about the final baseball game of the season played between 1 of 29 teams from the US and one team in Canada and call it the “World Series,” and yet the Brits still insist on saying that World War II started in 1939 in what sense was it a world war at that point?

AUDIENCE MEMBER: - _____

DR. DYLAN WILLIAM: - Was it a world war? I mean basically, Britain declared war on Germany and Germany declared war on Britain and Poland declared war on Germany and France did the same. Japan is in Manchuria, but Japan and Germany are not at war at this point. So the interesting thing is what does it mean to be a world war. World War I wasn't called World War I, when it was on it was called The Great War. So, someone once joked the Stone Age did not start until 1850, cause 1850 was the first time anyone called that period of time the Stone Age.

So, this is a great discussion question. I mean, we could spend hours on it, but the point is, again, I learned nothing about the quality of your historical thinking by hearing your choice. I have to hear your reasons. So, again, no point in asking the question unless you're going to spend 20 minutes on the discussion. Remember, earlier on I talked about the exit past question about what historians are concerned with bias? We didn't put the kids answers in the trash; we actually chose the most interesting ones to make up our multiple-choice question. So, these are some of the more interesting kids responses. People can never be trusted to tell the truth. C is interesting. People are only able to provide meaningful information if they experience an event firsthand. I think that this teacher has been spending too much time on the importance of primary sources. I think most history teachers would agree that D is the best answer, but if you have been teaching this and kids vote for D, then the kids get it, move on. So this idea of these "hinge" questions; we call them "hinge" questions, because the idea that every teacher plans every lesson with a "hinge" in it. You don't have a lesson plan like a railway track where you start at the beginning and run through to the end no matter what. The idea is to build in some contingency, some uncertainty and so at some point in the lesson you check to see whether the kids are still with you in the same way with the pilot of our plane last night checked to see if we were still on course and make an adjustment. So we call these "hinge" questions, because you actually pitch a question at a certain point in the lesson and if the kids are with you, you do one thing and if they're not you do something else. The idea is you build it into your lesson design.

MFL - is the verb "et" regular in French and looks like a very boring straightforward question, but of course you can extend it to other tenses and the present. So you can have a discussion about that.

This question is from teachers from Chico in California teaching more than foreign languages, but teaching Spanish. And I think this is a really good question actually, because we know that native English speakers have 2 difficulties with Spanish pronouns, one is which one should you choose? And the other is where does it go? And this question is sneaky, because some of these options have the right pronoun in the wrong place. Some of them have the wrong pronoun in the wrong place. One of them has the wrong pronoun in the wrong place and one of them has the right pronoun in the right place and that's C so C is the correct answer, I believe. But what's great about this question? It is, if kids are getting it wrong, you know what they're getting wrong. So it's not just a matter of knowing which answer, but actually being able to use that information. Now, some people are worried about this. They say, when I talk about these, because of techniques getting kids to hold up their answers, people say, "Well that's very scary." And I say, "Why?" "Well, you might get it wrong." And I say, "Why is getting it wrong scary?" Well, you should know this stuff, but you're in school, I mean if you know this stuff then the teachers giving it, giving you stuff that is too easy. And the whole idea that getting things wrong in class is somehow embarrassing or shaming is very strange. It's a bit like going to the doctor and lying about your symptoms isn't it really? Covering up? The only point about being in classrooms is to be stuck and confused and wrong. If it's not confusing to you then it is too easy.

You know earlier when I told you about the A,B,C,D cards. One teacher I work with she only uses only 4 responses A,B,C,D and if at least 3 kids choose every answer she sends the kids to the letter corners, because she's labeled the 4 corners of her classroom A,B,C,D, so your task is if you believe C is right to gather with the other people that think C is right and your task is to convince people in the other corners that C is the best answer and you see this little boy in the C corner listening to his colleagues and beginning to think that C was not such a smart choice after all. So, what he starts to do is to kind of edge over towards the D corner and the reasoning he is edging is because he thinks he's cheating. I think he's learning.

A teacher that I work with in Scotland has got a poster on her wall, which just says “Stuck? Good. It was worth coming in today.” And I thought, wow! That's the kind of message we should be sending shouldn't we? About if you're not making mistakes then you're probably not pushing yourself hard enough.

Okay, so I just wanted to finish this that off by talking about the design of these kinds of questions and I want to illustrate it with this question here, so here's the question. There are 2 flights per day, this is actually a released nape item from 4th grade. Actually, I hope it's a released nape item, because if it is not a released nape item, I have just committed a class E felony. But, this item is a bad item. Spend a minute in your groups thinking about what's wrong with this item.

Okay, any ideas about what's wrong with this item in them. Any suggestions? You don't like to read your hands? Yeah.

AUDIENCE MEMBER: - There's no AM or PM.

DR. DYLAN WILLIAM: - No AM or PM.

AUDIENCE MEMBER: - It's almost like where…

DR. DYLAN WILLIAM: - That's right. Yep, you have to make a lot of assumptions of that kind. Anything else?

AUDIENCE MEMBER: - indiscernible.

DR. DYLAN WILLIAM: - Yeah. We don't know if its some type of plane; we don't know if the winds are the same from time to time. You have to make a really large number of assumptions to get her right. Yeah!

AUDIENCE MEMBER: - Indiscernible.

DR. DYLAN WILLIAM: - Yep, these are all of the kinds of issues that the teachers raise and you know what, none of them matter, because the students know they're not in the real world there in this strange place called test land. Where every

piece of information given to you has to be used exactly once and none of those things matter, because kids know that I'm going to be playing this game. But what seriously wrong with this item is that kids who thinks there is 100 minutes and an hour will give the correct answer, because the time calculation does fortunately go past the hour. And all that you need to do to make it a better question is just to make the flight time slightly longer by going from 9:05 to10:55 so it's one hour and 50 minutes in duration so that then it arrives after 4:00 o'clock. So, this is a bad question, because kids who think that there's a 100 minutes in an hour and kids who think that there are 60 minutes is an hour gets the same answer, but kids can get it right for the wrong reason and that's the crucial difference. And all that you need to do to make it a better item is just change that 20 to a 5. And this is the process we recommend that teachers use to publish these items.

So just a schematic there to really crystallize this. These items if they're to function way that we want them to it should be impossible for the kids to get it right for the wrong reason. So we never want a good way, a correct way of thinking about this, what I call a cognitive rule, and an incorrect cognitive rule to map onto the same response. It doesn't matter if 2 different cognitive rules that are incorrect metal to the D option and 2 up in the air option, but it mustn't ever be the case that correct and incorrect cognitive rules map onto the same option. We call them "hinged" questions. Here's the main designed requirements. Don't slow the lesson down too much. Kids must answer in 2 minutes and must be able to collect an interpretive responses from all students in 30 seconds and teach them to be able to eyeball the whole class and make a quick decision and their the priorities ideally all 3, but the first one is the most important in no case should correct and incorrect cognitive rules map onto the correct option.

Okay, that's the idea of a "hinge-point" question, but we can go further. We can incorporate these end to end-of-class quizzes. Now, I have never understood why a teacher spent too much time on quizzes, because it gives teachers a lot of grading. So we actually think of ways of response to intervention that are much more flexible. So here is one way of doing it. Let's say you've been teaching figurative language and then you ask the kids, what you do is you give them the list on the left on the board and then you hold up and read out the list on the right, so you read out to the kids, "He was like a bull in a china shop," and you hope that every kid votes, G. This backpack weighs a ton, B? The sweetly smelling sunshine, A and F. Yep. He honked his horn at the cyclist, so it's on matter and alliteration. Five is not very good, five is my attempt to produce a short version of irony. He was tall as a house, again is a simile, but is also probably an exaggeration and therefore a hyperbole.

Now, you weren't really playing along with, so I'm going to make you do it again, but with a math item. So, let's say I've been teaching you about lines of symmetry. Okay? So, quick class quiz now. Hold up the right number of fingers for the number of lines of symmetry that shape A has. How many lines of symmetry does A have? Vote now please. Come on, it doesn't matter if you get things wrong I just want to know, okay B, B, C, D, E, and F. Thank you. Okay, some of you are going to need to see me

later. But, what I do now with a class like is to point out that E is actually a rhombus. It doesn't look like it, but it is a rhombus; it has 2 lines of symmetry, but it's not actually the way you would expect to see it and I reinforce that with the whole class and then I pick it up with the individuals, but do you see what I've just done now? I have just administered and graded and remediated the whole class test in real time. Less work for the teacher and a much more direct impact on the students learning. So this is what I mean by response to intervention, it's, it's by all means let's carry on that everybody else in this conference is talking about, but that's also how this very tight timescale as well so that we actually end up improving the classroom practice.

Okay, so how do you take this forward in your own school? Well, as I said earlier today, "No leader can do the learning for the teachers in the same way no teacher can do the learning for the learner." What you can do is create a situation in which teachers expect to improve their practice. One of the push-backs that I get from teachers is that they say to me, "This is very scary." "You are asking us to take risks." I do not think that what I asked them to do is particularly risky, but teachers are very risk averse.

So, in order to give leaders some ammunition and we decided to look for some cases where people really do have to take some quite risky decisions and hear's the case we found - about one in every 4000 babies is born with a condition called transposition of the great arteries. The aorta should come out of the left side of the heart and it actually comes out right side of the heart, obviously therefore it's very serious, because the blood system is not getting oxygenated blood and for many years the best procedure was called the Senning procedure, which is putting a little baffle into the heart making a small hole in the ventricle wall so that some of the right blood gets to where it's going to. The problem is, that they got quite good at it so only 12% of babies receiving this procedure died, but life expectancy was only about 47 years. So there is great interest at Great Ormond Street Hospital in London in improving outcomes and they wanted basically to correct the plumbing. So, cut the aorta, cut the pulmonary artery and reattach them where they should be on a 2-week-old baby.

So here's what happened, the early death rate in the Senning procedure was 12%. So over the first hundred or so cases about 12% of babies died, so each step horizontally is another baby with this condition, each step vertically is another baby death, and from the first hundred or so there is about a dozen deaths. Had they carried on doing what they were doing over the first 200 or so they would have ended up with 30 baby deaths, but as the doctors were learning this new procedure, the death rate practically doubled, but after another hundred or so cases they got perfect. So after the 273rd case not a single baby died and the outcomes were really quite extraordinary. This is the life expectancy curve, so the blue curve here shows you a life expectancy as a normal adult and the curve shows if you're 20 what's your chance of making it to 21, pretty good. If your 80 what's your chance of making it to the 81, not so much. So blue is the normal population, Green was the population who had the Senning procedure and look at the population that student and the kids who had the new switch procedure, almost the same as adults, reflected in increased life expectancy. Up now to 63 years an extra 16 years of life for every person who has had this procedure, because of the

new procedure. But the price is, that 15 babies died who wouldn't have died had these doctors played it safe.

So when teachers tell me what I've asked them to do is scaring and risky I say, “Get over yourself.” That's scary. If you screw up, maybe kids don't add fractions too good for little while, you know. If these guys grew up, babies die. So I don't know if that's useful to you, but I think teachers can be too precious about their practice and I think it's quite useful to use examples like this from other areas where I can actually say to them, “Get real.”

Okay, finally, Teacher Learning Communities. So, I just want to finish off by sharing with you what we've learned about how to support teachers in doing this. We think, that the best way for teachers to develop their practice of this kind of minute to minute and day by day formative assessment is to setup a self-help group. We call it a teacher learning community, because if you're not a teacher you can't be a full member. Two reasons - one is that a lot of district staff fondly imagined they used to do all of this stuff when they were teaching and they really didn't, but most importantly as soon as you left the classroom you forget how difficult it is to change your practice and so they can be supportive, but they cannot be full members. Only in people who are still trying to change their own practice can be full members.
Optimal size of groups we think is 10 to 12. Composition doesn't seem to be very important. What is important is monthly meetings. We've tried other frequencies, monthly is best. Ideal duration is 75 minutes and then time between meetings for collaborative planning and for peer observation and maybe necessary waivers from school policies.

The other thing that I am not really quite Stalinist about is having the same structure for every single meeting and people say it gets very boring. Actually it doesn't. It gets predictable and familiar. Can you imagine a medical student saying to the attending, what are we doing tomorrow? “Ward rounds, ahhh.” “Can’t we do something different; we did ward rounds today?” Yeah and you know what? We're going to do ward rounds tomorrow and the day after that and the day after that, because ward rounds is how you learn ward medicine.

And what's interesting when you have what Lee Sherman calls a signature pedagogy, is that everybody comes to the learning setting knowing what roles they have to play, so there're not actually spending the first half of the session working out what they're meant to be doing. They know what they're meant to be doing and they can focus on helping each other without professional learning and we think that each of these might make sure that there is the same structure, introduction, some kind of a starter. The active ingredient is everybody knows that they have to report back about what they tried out and how it went. To keep some novelty, new learning about formative assessment you can do that and you can buy some materials from us for that or you could just do a book study or watch some videos, you know wherever you like to keep it fresh and then personal action planning. So, if I'm going to come into your class room to watch you and your going to come into mine we get our calendars out and we

fix the time, because our experience is if we don't have a date in the diary before we leave that room it isn't going to happen and then finally review of our learning. Did we actually achieve what we want to do? If yes, great. If no, what we're going to do about it? People worry about the leader of this group. "Who is going to lead this group? How are we going to train the leaders?" Don't. Don't train the leaders, because the leaders you've already got people with the skills you need. You need somebody to get the meeting to happen, to follow the agenda, to maintain the collegial supportive environment, but our experience is that when somebody is in that group who thinks that they're an AFL expert does less teacher learning, because they end up telling people what to do. This is not a model of other people telling you what to do. The idea is that each teacher goes along to this meeting with a personal agenda and getting the support of the rest of the group in delivering that agenda. It's got much more in common with Alcoholics Anonymous than it does with other models of professional development. It's about each person making a personal commitment to themselves, but then getting the support of the group to deliver on that.

Finally, a quick word about peer observation. We've had a lot of trouble with unions and some districts who are worried that this creeping performance management and they're worried about the effects on teacher tenure and things like that. The trouble is peer observation in many districts; it's not peer observation, it is being observed by your boss. And they call it peer observation to make it sound acceptable. Well, to me peer observation is when you're being observed by equals. So to make it absolutely clear that this is not performance management we have a very strict protocol. So if you come into my classroom to watch me, I tell you what to look for, because you're working for me. I'm on working on wait time. Here's a stopwatch. Measure my wait time with these kids and then the clincher at the end of the lesson, any notes that she's made belong to me, because when she is in my classroom she's working for me and when I am in her classroom I'm working for her. This is not sharing good practice. If she gets anything out of this that's a bonus. The main point of her being in my classroom is to help me see stuff that I can't see, because I'm too busy teaching. It's about me having my own professional development agenda and getting the support of my colleagues into what I want to do and not being told what to do by somebody else. So we see that as a re-professionalization of the practice.

So, I am not going to stop and take questions now, because we have used up our time. I am happy to stay behind and answer individual questions. I will now hand over to somebody to give you the secret code so that you could actually finish.

MODERATOR: Please join me in thanking Dr. William for being here.