International School of Paris
Educating *for* complexity

Embracing Change: Towards a Research-Led Learning Community

Keynote speaker Sugata Mitra speaks about the future of education (transcript)

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Firstly, I'm very happy to be here, in this remarkable city and at this remarkable school. And I appreciate the fact that you're trying to *do* something about the future—not many do. Particularly in education we have this great inertia. It doesn't change. So if you're a school principal, and you figure *I need to change something*, you're worried that if you shake the system, a lot of people might object—the parents firstly, the politicians and sometimes even the teachers. Somehow, when it comes to education there are two things that go wrong. One is that we quite irrationally believe that our children should be educated the way we were educated. It doesn't make any sense actually, but if you search inside, you'll find a little voice that says, "*That's safe because I'm not a lunatic—as yet—so if my child goes through the same system, then maybe he or she will be alright."*

The system doesn't—and by *the system,* I mean the political system or the rulers—they don't want to upset people. And the easiest way to upset people is to mess around with their children. So they lay off.

You might have noticed if you look at politics around the world, every politician that comes to power, before coming to power says, "I will make sweeping changes in education." And immediately after coming to power, they get busy with wars and that sort of thing. This happens. It's been happening forever.

What I'm going to tell you now is sort of the sequence of events, really. It's not as though I am going to explain to you that this was my plan, and then I carried it out, and here are the results. It's not like that. I'm happy that I'm speaking to both parents and teachers—you'll probably appreciate what I'm saying. I am a reluctant sort of entrant into education. I didn't study education as a subject. The subject that I studied was theoretical physics, and I studied it at a time—a long time ago—when theoretical physicists were the only people—along with mathematicians—who knew how to write computer programs. So we all got jobs as computer programmers, not as physicists and mathematicians … lucrative jobs. So, I was one of them. Once I got this job, because I had a PhD they said, "Well it's obvious that in addition to writing programs, you should also teach other people how to write programs." So that's how I got into teaching in the first place. And as I went along, a peculiar problem surfaced.

I'm going to come to that picture later on [shows picture on screen], but I could for example just leave it in your mind and say, "What do you think is happening there?" And you could have lots of answers. One of those answers could be that it's probably a drop of water falling into a pond or something. Then if you look a little more carefully, you might say not only that. It's probably the second or third drop because something else has already dropped inside. That's why there are ripples there. Leave that thought there. We'll come back to it.

The peculiar problem that I ran into back in 1999 was that I was teaching a very expensive course, at a very fancy institute on computing systems, computer programing and that sort of thing in New Delhi. And as it happens in developing countries, right outside was a big slum—an urban slum with lots of children there. I must make a point here that it wasn't that I had any altruistic feelings at that point. My thought was a purely practical, statistical thought. How many excellent computer programmers am I missing in there? And isn't that a shame because we need programmers. Why do I have this little lot of people who can afford a lot of money and make them into good programmers, and perhaps in the process lose out on a hundred potential programmers on the other side of the wall? The wall was a physical wall. It separated my office from the slum. Nothing could be done.

And then another thing was happening in the 90s. The personal computer was beginning to come home. For those few people here who might still remember, we were actually very excited. "I can buy a computer and I can bring it home!" Because computers were as big as this room. They were inside institutions. So the PC had arrived, and we started buying them. It was several months' worth of salary. I bought one. My friends bought some. Then I noticed something peculiar. First, in my house. I bought my computer. It came in a big cardboard box—a big monitor like that, a big CPU. It had two floppy drives, and it was powerful in its day. So I was unpacking it. I remember I was unpacking it, and I noticed a little fellow, my son, who was about 6 years old, from the corner of my eye, standing behind me. And I still remember, ladies and gentlemen, in spite of what I'm going to say for the rest of my time, I turned to him and said, "Don't even think about it. It's an expensive machine. It's a computer. It's very, very sophisticated and complicated."

The same thing was happening in my friends' houses. But you can't keep things out of the reach of six year olds. As all of you know, they always have their way of getting there, whether it's a car or a washing machine or whatever it is. So one of my friends said, "You know, Sugata, my little girl, I think she's gifted." I said, "Oh, why do say that?" And he said, "The other day, I was stuck. I was working on my computer. I was stuck because everything was going up the screen very quickly. Before I could read it, it vanished." And remember there was no Windows or anything in those days. "So I was sitting there waiting, thinking, 'How do I solve this?' when my little girl came up and said, 'Why don't you do DIR/W/P'? So, do you think she's gifted?" I said, "Well, I don't know." And then more stories like this kept on coming. I thought, this is a very interesting thing happening here. The children of rich people are all becoming gifted! Of course, I didn't for a minute believe that they were gifted or anything. And then as I was walking to my office, this thought sort of came into my mind as I looked to my left and there were all of these ragged children playing cricket. I thought, "They're *all* gifted. They must be" in that sense. I must give them computers. But where do I get the money from? Well, I'll give them one. So I saved up again. My boss gave me some money, and I bought a computer. But where do I put the computer in the slum? You can't just put it on a table or something like that. So I made a hole in the boundary wall, a rectangular opening. I put a glass bin, put the computer's monitor against it, put the CPU on my side of the wall, bricked it up and left it. On the other side, you could see a screen three feet off the ground and a little touch pad. You can see it there [pointing to the screen]. It was sort of a DIY ATM, something like that. What it had on the screen was the Windows of those days—1.0, 2.0, or something like that—and a browser. It had no software. I didn't put any software on it. I didn't know what to put. It was just a plain browser. I left it there. I turned it on, on the 26th January, 1999. I took an internet cable from my office—quite illegal—and plugged it to the back of the machine to give it internet access. That computer had the most powerful boundary I could get those

days which was 2 Megabits per second. There it was. It was three feet off the ground. It was surrounded by children immediately, but they didn't touch it. They stood there. I thought, "This is not going very well. They're not doing anything." And I think at that point I entered into your field, education, because I realized that if you are wearing a tie and you're standing there and staring down at children, they won't do anything. They think the safest is to just stand there. "I don't know anything. I didn't do anything. I didn't touch anything." So, I got my first lesson in education. It's not because of the computer that they were not doing anything, it was because of me. So I turned around and walked off. As soon as I walked off, I heard the voices of children behind me and a few hours later they were surfing. Surfing. In what language? It looked like English. How? They're not supposed to know any English. I don't know. People kept asking me, "Who taught them?" The press didn't believe it. They said, "This guy must have taught them quietly on the side, and he's saying they picked it up by themselves." So I repeated the experiment because I thought, "Well maybe one of my students had actually shown them." So I repeated the experiment far away from Delhi and put a computer in a little village. I went back there after a couple of months hoping that the computer would still be there. It was there. There were children on it, and they were playing a game. But I did not put any game in the computer. They saw me and said, "Oh, you're back. We need a faster processor and a better mouse." I thought, "Where did they learn this from?" So they made a complaint—my second lesson in education. They said, "This machine"—they called it a machine—"This machine works in English, so we had to teach ourselves English in order to use it." So I thought, "Ok, this sounds very simple. You taught yourself English, but then where did you get this game from?" Mistake. You should never ask a child that. You know this. If you ask a child, "Where did you get that from?" The first reaction is "I didn't do anything." So the children looked scared. I said, "No, I'm very proud of you—that you got this game from somewhere. Did somebody give it to you?*" "No*." "So… it was in the computer, and you found it?" "No." "So then where? Where did you get it from?" And very hesitantly, they said, "From *THERE*." And I still get goosebumps when I remember that line because I figured that they were sensing the internet. They knew it wasn't the computer. It was *THERE*. Do you realize today, if I could ask you the same question, I could say everybody knows there's the internet. All of us use it all of the time, etc. So *where* is it? I think you'll find that the only answer you can give me is that old answer: it's *THERE*. Networks don't have a physical existence. The internet is our first creation of a non-physical but tangible thing. We created it. We must remember that.

So, there was the hole in the wall, and everybody was asking me, "How does it work?" Yes, they learned how to play with the computer. They're downloading games from the internet. They're installing those games, playing them, but how? What's the mechanism? We know now that there were no teachers there. And I didn't know they called it "the hole in the wall." I think that I have a few clips which you might enjoy seeing from the scratchy videos from 1999.

This is the first day of "the hole in the wall" [refers to a photo on screen]. This guy on the right is eight and to his left is his student. She is six. He was teaching her to browse, for heavens' sake, in English. And then hundreds and hundreds of children … big buzzing noise [refers to video]. The Delhi government put in 30 of them in different slums. Everywhere, it was like a clustering of bees. I asked a child, can you change the color of this picture that you've painted. She pulled out the color palette in Windows and showed me how to do that. That's in less than a month. So what does it all mean?

I published all the results, and they're still available on the internet quite easily—that groups of children can learn to use a computer on their own. But you must notice a couple of the important words there: *Groups of children*, *unsupervised*, *in the presence of the internet can learn to use computers by themselves*. If you take away any of these words, it doesn't quite work. Change the *groups* to *one*—doesn't work. Change the *supervision* to *just a little bit*—doesn't work.

Not intuitive. I've been a teacher all my life, and it didn't come easy to me to figure out that. But that's the way it is. So what is it then?

I came to England in 2006. I came because of a research project which my colleague, Professor James Tooley, got—a big research project to improve the quality of schooling in disadvantaged areas in India, of all places. So, Tooley called me and said, "You are the man. You should be doing this." That's how I ended up in Newcastle. There I was, working with Indian schools out of Newcastle. By the way, Newcastle—if you imagine the map of England—is up north from London, fairly close to the Scottish border. It's about an hour away by train from Edinburg. North-East England is a poor part of England, but it has a very rich history of engineering. It is there that George Stephenson built the first working steam engine and the big ships of those days were also all built there. All the coal that England had was mined there in Newcastle. But all that is history. Right now it's just a poor little corner of England. And there I was in those schools. The school teachers said, "Fine, you're working with all those children in India. What about them?" So I started going to the schools in Gateshead across [the river]. There's a river called the Tyne which is why Newcastle is called Newcastle upon Tyne. And just across the river is a city called Gateshead. I lived there. So I went to the schools in Gateshead, and the teachers said, "Let's do *the hole in the wall* experiment in Gateshead," and I said, "No, I won't do it." They said, "Why not?" So I said, "You know, you can't do *the hole in the wall* experiment in England or anywhere in northern Europe because all you'll get are frozen children." You can't do anything outdoors. So they said, "Come on, there must be a way. Whatever it is—we'll put halogen heaters like they put outside at bars." And I said, "No, you don't have to do that." What I did was I turned "the hole in the wall" inside out. And here's how you do it. It's the simplest way possible.

Take any classroom. Rearrange the furniture a bit if you can. I'm sure in schools like yours, everybody has a computer. So the place is overflowing with computers, but take them away... If you have 25 children, or 24 children, keep six computers—a one to four ratio. That's the number I learned from "the hole in the wall." Take six computers, preferably with big screens—I'll explain why later—and scatter them around the classroom in such a way that standing anywhere in the classroom you can see all six screens. And if you're a child working on one of the computers, you can look and you can see all the other screens. So you can see what other people are doing. Then I brought my 24 children in. They came in and the first thing they said was "Where are all the computers?" I used my "hole in the wall" language and I said "I don't know. I have no idea. We just have six." "So what do we do?" I said "Well, I want you to find out something for me." And I made up a question. We call them big questions, and they're kind of fun to make. So, a big question could be, for example—I did one recently in America with a group of children. First you make them sit down. "I'll tell you about the computers later. First, sit down." And I said "What do you see with when you see things?" "Duh, we see with our eyes." "So if you didn't have eyes, what would happen?" "Oh, we wouldn't see anything." So I said, "OK, then here's what we'll do. Just close your eyes and don't open them till I tell you to." So, they're sitting there with their eyes closed. I give it a few

seconds – about 10, 15. Then they start fidgeting. So then I said, “Okay, you can open them now.” Then I said, “Why were you fidgeting?” And I’m keeping my fingers crossed, and I get the answer I want. From one corner, a couple of children say, “Because we were seeing all sorts of things.” So I said, “Yeah? Like what?” *O*ne hand goes up. “I saw a bus full of aliens.” So I said, “Oh, so you can see without your eyes.” And there’s a “Huh?” And I said, “Yeah. Do you have dreams?” Of course they have dreams. I said, “Well, tell me your dream.” And somebody tells you some dream, and I said, “Isn’t it funny. We have eyes to see with but we can see without them. And at night when our eyes are closed and we’re sleeping, then we see a whole lot of things. Why do we dream?” Then … pause. And now the nine years olds—they were nine year olds in Austin, Texas—the nine year olds are quiet. And when that happens you’ve got their minds. You can hear them going, and then they say, “Oh, because of this … because if something bad happens during the day, you can see…” And I said, “Okay, let’s not make random theories.” I use that language. They love that language. “So let’s not make random theories, let’s check it out. There are six computers in this room, with internet connection. We have a big question: why do we dream? Go for it.” Then give them 25 minutes or 30 minutes and what you’ll see is what you saw in those clips… the humming like bees and the scattering from computer to computer. Because remember you’ve lifted all the rules. You have not said, “You have to sit. You can’t make a noise.” You haven’t said anything. They’re moving around, running. It takes a little bit of time for them to get used to the idea that this is for real. You’re not actually going to do anything. You must make sure you step back, and for heaven’s sake, don’t say, “Please be quiet.” That will wreck it. There will be a lot of noise. In Austin, Texas at the end of it… “Yes, dreams are probably the brain trying to sort its data out during night.” So, one lot. I go group by group, because there’s not enough time for everybody. I say there are six computers—let’s have six presentations. Six people talk. The first one says this. The second one says, “Oh, dreams, they are like stories. The brain’s trying to tell us a story.” I said, “Okay, so based on experiences of the previous day the brain is trying to tell us a story.” And it goes like this. You build on them. Never value add. Even if you know everything about dreams, don’t tell them. Just keep accumulating the stories. And then by the time I got to the fourth or fifth group, I got, in this particular case, the group came up— three or four children— and they started off by saying, “There was a man. His name was Sigmund Freud…” And I said, “I think we’re running out of time.” I didn’t want to go there. That’s the power of a self-organized learning environment. It can just take them anywhere. So what’s the purpose? It’s not serving any curriculum. It’s not going to make them do better in exams, but you tell me as teachers, is it not worth doing? We’ll see.

We call them self-organized learning environments and the idea went viral actually. I used to go from school to school doing demonstration sessions with all kinds of big questions. I’ll give you more examples of big questions later on. They sound simple. They’re the kind of thing that a child would desperately want to know “Why?” because they’re so absurd. One of them that I tried was with fingernails.

“What would happen if you don’t cut your fingernails?”

“They’ll grow.”

“How big will they grow?”

“Oh they’ll grow that big.”

“That’s it?”

“No, no, they’ll grow bigger.”

“So they’ll grow bigger and bigger and bigger. Will they grow across the Tyne to the other side?”

“No, they won’t grow that big.”

“So they’ll grow big, but then after some time they won’t grow any bigger?”

“No.”

So I said, “Okay, we’ve got a question there. Why do they grow in the first place and why do they stop growing?” Leave it with that. You’ll get back anthropology, evolution, cellular biology, DNA replication, the works … in 40 minutes.

This slide simply says what I just told you—how to set up a S.O.L.E. (Self-Organized Learning Environment). It’s available on the internet—and how to conduct it. Do try it. It’s great fun. It takes only 45 minutes. I did this experiment over and over again, and finally I had to write this, which is hard for a teacher to write. Let me assure you that I haven’t found any exceptions to it: Unsupervised groups of children in the presence of the internet can learn anything by themselves. So there.

What do I mean by *anything*? People, all of my colleagues at the university, are up in arms about the depth of learning, deep learning, etc. Well, I have all the answers to that, but it’s too long of a story to tell. Let me give you an example—a nine year old in Gateshead. I go up there and say, “Ok, I’ve got a question. Imagine that there are two pencils, one over here and one far, far away, somewhere in China and they are exactly identical. Is it possible that I do something to this pencil and instantly, at that point, the same thing happens to the other one?” They say, “No, that can’t happen. How would it happen?” “If I break this [pencil] and snap, the other one breaks?” “No, it can’t happen.” So I say, “You know what? Somebody told me that maybe it can.” Okay, important point: You don’t say, I know for a fact that it can under certain circumstances. That doesn’t work. “Somebody told me. Do you want to check?” So they went at it. The buzzing noise, the silence when I know that something’s crystalizing. And then the presentation. “Yes, Sugata, you know it’s possible, there are some particles which can be at two ends of the universe and whatever you do to this one, the other one behaves the same way.” I said, “That’s absurd. I don’t believe you. I don’t believe a word of what you’re saying.” And they said, “Sugata, have you not heard of quantum entanglement?” So I said, “I can’t even spell it.” So now, did they understand the physics of quantum entanglement? Of course not, they’re nine. But in their nine-year old way, they’ve understood a concept that is at the forefront of theoretical physics right now. And they can explain it to you. Don’t you want it? Well the system doesn’t ask for it. We’ll come to that in a moment.

But before that, let’s come to this whole thing about *How does it work?* I could put that question not with the S.O.L.E.s, but with a flower. Does it know it’s a flower? Does it know that it’s beautiful? Does it know that it’s symmetric? How does it design itself? Does it? We don’t seem to know anything about this. So what’s going on? All that we know is that the molecules are connected to each other. Whatever happens to molecule number one affects all the other molecules. And whatever happens to all of *them* affects molecule number one, and so on for all of them. You saw in his last slide the one and the many. I can show

this to you with a tiny experiment, if you allow me to. It just takes 5 seconds to do. What I want you to do is, I want you to clap synchronously. Can you do that please?

[Sound of clapping]

Okay that's it, thanks. So if you record that and play it back in slow motion, you hear the first few instants of chaos. And then something brings the claps together. So now if I ask you, "Who brought the claps together?" Was it the head of the school here? Maybe he did it somehow. And he will say, "I was just clapping." I can ask anybody and they will say no. So nobody in this room brought the claps together. But they just came together. Who decided the frequency? Nobody. Who decided the volume? Nobody. So what am I supposed to conclude? That there is something in this room that is not human. What else can I conclude is bringing the claps together? How do the claps come together? We don't know. You know what? After 2,000 years of math and physics, we still don't know. We only know this much—when you clap, everybody else can hear your clap, and you can hear everybody else's clap. And this goes on. The rhythm of [.....]. And out of that comes order, synchronous clapping.

It's been known to physicists and mathematicians. It's got a name. It's called a self-organizing system. And we see it in nature all over the place. This flock of birds… how does an individual bird inside that know which way to go or who to follow? But they form this pattern. How? We don't know. Let's go back to my second slide for a moment. We know this—that out of a chaotic situation, like you just saw, you can get spontaneous order. It comes out of chaos. We don't know exactly how, but we know that it does happen. Watch this [shows video to audience]. Do you see that? The picture I showed you, when I said it's a drop falling after another drop… It wasn't. It was a drop rising, created by the pond. In response to what? Memory of that first drop? Did it recreate it? But it can't think. Or can it? Every water molecule is connected to every other. The first drop shook a whole lot of them. Those affected the others. The one affected the many. The many affected the one, and created that drop, exactly identical to the first one. So what was it the picture of? Not the original drop that caused the ripples, but its ghost, exactly identical to it, rising from inside. If that happens in a thing like a pond, can't it happen with humans? Is that what's happening at "the hole in the wall," or in the self-organized learning environment? We don't know, but I'm just leaving this as a guess.

So basically, a S.O.L.E. is like a mildly chaotic situation that you create. You put in a question, like a seed, and then you wait for spontaneous order. Is that the only place where this is happening with our children, or are there others? Well think about it. When you tweet, your tweet affects the tweeting of millions of people. It affects your friends, your friend's tweet, then others and others and others. And all those tweets change your tweet. If you let that go, if a society lets that go, why will it not get spontaneous order? What will that order look like? We don't know.

Let me just go back for a second. Teachers sometimes ask me, "What's the role of a teacher in all this?" I would like to put it this way. You're not a guide. You're not a supervisor. You're not a coordinator. You're a friend. That's the role. Because of the nature of the internet, you can only be that. You can only say, "You go there. I'll come with you." That's all. You can experiment with that role and see if it works. I'm sure many of you already can sense it.

Now all of this works, and it can be amplified with admiration. And it's not easy, I mean, it's not hard to provide that admiration. Like when those children told me about quantum entanglement, what can you do except say, "My god you got that in 24 minutes? That's incredible." And they love hearing that. They go back home and say, "There was this question about the two pencils, and you know Sugata— Sugata is supposed to be a professor— and he didn't know the answer. We told him!" And the parents call back the principal, "What's going on in the math class?" It's very nice. You have to admire the process. If you admire the process, they amplify. I thought about who in our lives does that, or did that? And I think you might agree, that parents and teachers use discipline. We tell our children, "Work hard. Do your homework. Practice more. Look I'm breaking my back making money so that you can study. Don't waste your time." There's one person who doesn't do that. For the lack of a better— I mean I'm not being gender biased— but it's the grandma … or the granddad. What does she do? She says, "What are you doing with that phone? Oh my goodness, I can't figure out anything. How did you do that?" And you know what the child says? "Oh that's nothing! Let me show you something else!" She drives a pedagogical learning spiral with just admiration. I thought of this, and I gave it a name. I called it the method of the grandmother. I wrote an article in the *Guardian* newspaper saying, if you have an internet connection, if you have a web camera, and if you are interested in children, can you give me one hour of your time every week for free? I got hundreds and hundreds [of responses], mostly retired school teachers but not all, every kind of person. But a name stuck because of the *Guardian.* The group itself was called the Granny Cloud. And everybody's happy to call themselves Grannies, whether they're men or women or children or whatever. They're called Cloud Grannies. They sit there in the internet, and now I don't have to worry about my slum in New Delhi. I can get them Granny, from up there, and she'll come. What does she/he do? Doesn't teach. It's terrible to teach over Skype. It's bad enough to teach in real life. What the Cloud Grannies do, is they have a conversation. They'll start off any old conversation. To give you an example, one Granny complained to me that she was connecting with a remote area in Bengal, India, from Britain, and she said, "You know the children, I had prepared a lovely story for them and I said 'Children, I am going to read a lovely story to you today,' and the children said, 'Oh no!' So she said, "Don't you want me to read this lovely story?" And they said, "No!" So then she said, "Well in that case, you tell me a story." And they said, "No!" So then she said, "Well what do you want to do?" And they said, "Are you connected from a laptop?" So she said, "Yes." "Is it charged?" She said, "Yes." "Are you connected with Wi-Fi?" "Yes." "Well, disconnect the charger from your laptop. Pick up the laptop, and show us what's in your fridge." She said, "I spent the next hour discussing supermarkets." So what a fantastic lesson about how do you select the […]. They had thousands and thousands of questions, including things like, "How do you know the thing inside the tin is not rotten, without opening the tin?" So that's the Granny Cloud. It started in 2009, and it's highly active now.

Here's an example of the very first days … Many of them do poems and things. They have conversations. There was recently a meteor shower, and in some of my remote areas the sky is crystal clear. So the Granny who dialed in made the children go out. She said, "Go out. Take a look and then come back and tell me what you saw." And the discussion was about astronomy and so on.

So is it spontaneous order that we're seeing? I don't know, but I sense it.

In 2013, I got this prize. It's called the TED Prize. You know, and it's not a bad prize. It's 1 million dollars. So you know when I got it, I felt quite happy. I was going to call my bank and say "No more three-digit numbers, we're talking real money here," when TED said, "That's not how it works." It doesn't go into your bank; it goes to your university and you have to decide to do a research project with it. So I defined a research project, bringing two ideas together. The idea of the self-organized learning environment and the idea of the Granny Cloud … put them together and call it *The School in the Cloud*. So it's *The School in the Cloud*. It's not a virtual school or a website. People get confused about that. It's a physical place. It could be inside your school, or whatever, but you just have to bring in the idea of the self-organized learning environment and the idea of the Granny Cloud. Not necessarily THE Granny Cloud—you can be the Granny—but the *concept*.

I spent the money building seven of them, five in India and two in England. This is one of the English ones, in a village called Newton Highcliff in the county Durham, up in North-East England. This is a school called George Stevenson High School. You can see that from the structure, it's not meant—you can tell by looking at the room—it's not meant for lecturing. It's meant for groups to work. The screens are big. Why are the screens big? Because everyone can see what's on them. And so on. It's extremely popular.

This is the remotest place I have on my list of seven. It's in the Sundarbans. The Sundarbans is where the Ganges River meets the Bay of Bengal, for those of you who can recollect the map of India. It's the largest river delta in the world, and it contains three kinds of things pretty dominantly: the royal Bengal tiger, snakes, and lots of children. There's no health care. There's no electricity. There's no schooling. There's nothing there. So in the middle of that, I built one of these things. It's solar powered, and it gets the internet. With a long pole over 40 feet above the ground, I got a 4G signal from somewhere. So I stole it, but now I know who provides it, so we pay him. We have good quality internet, and we have a few computers. You know the whole story. There's no teacher inside. There's a supervisor. This is another one. So what happens? The supervisor opens the door and stands aside. The children go in and they do what they like. Sometimes the supervisor gives them a question and says, "I wonder *something*." And waits for spontaneous order. Sometimes we get it; sometimes we don't. That's pretty simple.

What does it do? We studied it for three years across these two countries. First of all, it improves reading comprehension dramatically. Why? The internet doesn't know that they are children. So the internet throws everything it has at them. The children don't know what they're supposed to be able to read, and what they're not supposed to be able to read. They read everything and start quoting from the *Harvard Business Review* because nobody told them not to. The quotes are usually relevant. So I put a Ph.D. student on this and said "How is this possible? How can they read this? It goes against everything. It goes against Piaget. It goes against reading stages." She's just finished her Ph.D., just two days ago. She did a whole range of experiments. What we've got is—and I'll say this very briefly because [we don't have] enough time—reading is considered an individual activity. Everybody knows that two people don't read a book together. Why? Only for one simple reason: the form factor of the printing press. When it first started in the 16th century or whatever until now—8 by 11, A4 sized, folded into two, small print—it was all because of the ease of making a book. What we came to conclude from that, is that reading is a solitary activity, one on one. I think we made a mistake. If you take a screen, many children can read it, particularly a big screen. And what the S.O.L.E.s and *The Schools in the Cloud* are showing is that when they read in

groups, they read way above their individual comprehension levels. How? Spontaneous order. The claps come together. Try it, and you will be pleasantly surprised. If you do it over and over again, individual comprehension levels start to go up, naturally. But there's still a lot of work to be done, and if some of you want to try it, I would be absolutely delighted.

There's a general sense of well-being in the school. Why? Because the teacher is asking questions to which she doesn't know the answers. And whenever they find something nice, she says, "Oh I'll remember that" or something. I measured retention, the retention of SOLEs is definitely higher than the retention of a lecture. You can probably sense that. Listen to 45 minutes of talking. I could ask you my standard question: "If you think back to when you were nine years old and in school, can you tell me one lecture that you remember?" What you will remember are the little fights that you had with your friends, the time your lunch got taken by somebody else… You remember all those things. We go to school to meet our friends. I'm sorry I have to say this in front of so many parents and teachers. We go to school to meet our friends. It improves communication and collaboration. Why? Because they have to discuss with each other. They have to come to a consensus. Remember there are only six computers, and there are 24 children. So building consensus and collaborating happens without your ever having to ask for it. It has to because otherwise it won't work. And the last point, which I didn't expect, but got from this three-year experiment, it changes the teacher. It will change you. I can guarantee it. Whether you like that change or not, I don't know. What is that change? I think, in a way… how do I put it? It makes you an approachable human being. I mean—I hope you're not the opposite, but many of my teachers were the opposite of approachable human beings. That's what I know so far.

So I'll quickly sum up, but I need to tell you that's the end of the good news. Here's the bad news. This is what happens at the end of school in almost everywhere in the world… it's the exam. I know in the IB system it's a little bit different, the assessment, but for those of you who know the English system—the CSE, the *big* exams. What's an exam? You're asked a question. You have to answer it alone. You cannot use any assistive technology. You cannot look left, right. You can't look at anybody else. You answer the question. It's the opposite of SOLEs. So let me tell you this very clearly. If your students are going to sit for an exam at the end, the SOLEs will not do anything for them. The assessment system needs re-examination. It itself needs to be examined. We'll talk about it in a second—perhaps in the panel—but that's what it is. Where did it come from? It came from the system, the so-called system, from here [points to the slide]. This is an office from 1920. No assistive technology, no telephones, no nothing. There are just rows and rows of people—clerks. What's a clerk? A person who sits in one place for 8 hours a day, doesn't look left, doesn't look right, looks straight ahead, understands instructions and follows them exactly, and writes by hand clearly because all data was hand-written, and can do arithmetic in his head. Okay, that's where it came from. We needed millions of those people. The school was invented to produce them in large, predictable numbers. Are you producing the same? Because those offices don't exist anymore. So, you think. This is what exists instead—people clustered around the internet. That's where your children are going to go. So to prepare them for that life, shouldn't their exam look like this? That's the exam I want to see. I know it might be difficult for a school as a system to do it—for a principal—to say "I'm going to do that." That's hard, but not for you as a teacher. You can have a class test like that. Give it to them as a surprise. Put up a question … today's test. Put up the test on the board, and then say, "Well, what are you going to do?" They'll all sit quietly with their pieces of paper and all that. Then say,

"Okay, take out your phones." And then see what happens. Obviously you can't ask stupid questions that Google can answer in two seconds—that won't make any sense. But you can ask them one kind of question, where the internet cannot help. What's that kind of question? The question to which no one knows the answer. Can you do that? If you're a geography teacher, could you say, instead of saying, "Here are all the things I know about geography"… Instead search in your mind. What are the big unanswered things? What are the big questions we don't know in geography? And then ask them and say, "Use what you want." And then see what comes out.

This is what I'm suggesting. The use of the internet should be allowed during all assessment. Why not? We use the internet continuously, 24/7, to solve all our problems. The moment you go out of this hall, you're going to pull out your phone and do all sorts of things with it. Why would you not let your children do that? Why would you pretend in school that the internet doesn't exist? If the internet is dangerous for children, then isn't it the biggest reason why it should exist as a subject inside school? Like physics, or chemistry, or math? What is it? Where is it? Who created it? How does it work? Why is it harmful? What is harmful about it? Should we let our children learn that in the streets of Paris? Or inside school? You decide.

I think comprehension, communication, and computing should be our pillars, like reading, writing and arithmetic. You subsume them so reading goes inside the general area of comprehension, because we don't only read, we see things. We look at videos. We do all sorts of things. Communication. You can produce a video as quickly as you can write—sometimes faster than you can write. You can take pictures. You can draw, and you can do anything with that little phone of yours. So writing should be subsumed inside it. And what about scripted handwriting? How many of your children do you think will use scripted handwriting 20 years from now? Or even today? I mean, if I have to write one A4 sheet by hand, my wrist starts hurting because I haven't used it. So think about that, because I don't know what we should do with scripted handwriting. I think maybe we should make it a hobby, like knitting. You can take it optionally if you want.

I think the purpose of education should be to produce healthy, happy, and useful people. There's very little to argue against that. You define *useful* in terms of the society you live in, the school, the kind of children that you're bringing up. And then you will see it.

So then you have six ideas: comprehension, communication, computing, happy, healthy, and productive. You could make a matrix if you want and study it. Take something like dancing. Does it make you happy? Of course. Does it make you healthy? Yes, it does. Does it make you useful? Yes, it does. It teaches you a different kind of communication, using form. So it checks out. It should be there in every school. Compared this with the 17 times table. Do you teach that? All of us were taught, I think, the 17 times table. I remember up to 17 into 3. But anyway, does it make you happy? Not really. Does it make you healthy? I don't think so. Does it make you useful? Yes, it did, in 1920. Okay, you decide what to do with that.

So what am I working on right now? (I'll finish with this.) A curriculum, which is not about everything we know, but about the big things we don't know yet. Children love that. All of us love that. Is there life outside there? What's the purpose of the universe? Does it have a beginning? Does it have an end? What

is art? Why is it there at all? Do animals have art? Question after question after question. The big unknowns. What if we build a curriculum out of that? A pedagogy that is immersed in the internet. You heard throughout this talk that, without the internet, spontaneous order cannot happen. An assessment that looks for heuristics over process. Let me illustrate that. Do you have the—*heuristics* means do you know how to solve the problem. So instead of saying, "Solve this equation," you say, "What would you do to find out how to solve this equation?" And then evaluate that answer. Why am I saying that? Because that's the world we're headed to. We don't know what is it they'll have to learn, but we know they'll have to continuously learn things. Do they know how to figure it out? If you had to put a motto outside your school today, it should be figure it out. Should they know how to solve the equation? I don't know. You know, it's from a time when individual knowledge alone was very important. I call it Robinson Crusoe education. If you're stuck on a deserted island, and you need to solve an equation in order to figure out how many coconuts are going to fall in the next few minutes, then Victorian education would have saved the day. But you're not going to be stuck on a deserted island. And even if you are, you'll have a smart phone with you.

So somewhere in there, ladies and gentleman, I think is the future of learning. Thank you. Thanks very much.

One of my questions is … One of the points that comes up a lot for us is staff or parents being concerned about the use of the internet. One of the things I often hear is, "But we've got to teach. We can't teach. The responsibility is too big for us to be able to do that" and/or parents saying, "But they spend too much time on the internet. We really want control over it." And I just wondered what your thoughts were on it?"

Well, it's not an easy question. It doesn't have a straightforward answer. But what I've learned from all these years of watching children are a couple of things. First of all, internet access using tiny devices by individual children in a private place is dangerous. And that's what we've ended up doing. The industry is making the screens smaller and smaller, and we, unfortunately, in order to preserve our privacy, are sending the children up into their bedrooms with the little things. We're asking for trouble, and we're getting it. So we've got to change that. We've got to change that. I'll tell you one idea. I don't know how practical it is, but you know, in your home, the status of the TV that you have in your home--it's a big TV. It's usually in the living room, in the living space. Everybody can see what's on it. Why should the internet be different? Why can't you have another screen next to it, equally big, high resolution, 3D, whatever, and that's for wide open internet. I, from the hole in the wall, I know that it will reduce a whole bunch of problems, if you and your child are together. Remember, "You go there, I'll go with you". Okay, of course as they get to be adolescents, they might say, "Don't hang around all the time. Give him his own time." Doesn't matter. But that big screen helps immensely. Just think to yourself, if the only access you had was a 52 inch screen, and you were to do your Facebook on it, you'd think twice. So I did a SOLE on this in a school in North Yorkshire and the children told me a whole lot of things. They said there are two things: privacy and secrecy. And that privacy is not necessarily harmful. Human beings need privacy. Secrecy is not so good. Secrets can be a bit dodgy. So it's from children, but I think it's worth thinking about. It's not a very quick answer to your question, but the thing is, instead of blocking the internet—if you block the internet, the only thing your child wants to do is to see what's behind the firewall—instead of blocking it, discuss it. I mean, on your home TV, there are also adult channels that you could go to, but you know,

almost nobody does. Why? Because you know, it's kind of boring. I found *that* the best defense in India. When I've caught adolescents going onto these dodgy websites and pornography and things like that, and if I pop up suddenly, all of them sort of jump back like that. And I say, "What are you looking at?" And they sort of laugh sheepishly and all that, and then I say, "Oh that boring stuff? That's what *we* used to do when we were young. You guys are like 50 years behind your time." That kind of thing, just play it down. Make it ridiculous. And teach them—particularly the young people—about other people, instead of hiding them away from it. "Oh those wicked guys. Why are they there? What's wrong with it?" You know, even if it means discussing Sigmund Freud, do it. Bring it into the school. That's as far as I can go.

Can we come back to your spontaneous order? And I would like to ask the physician behind the pedagogue. What about the entropy principle in the second law of thermal dynamics?

I knew that question would come up from somewhere. Okay, let me explain where that is coming from. In thermal dynamics—there's a subject called thermal dynamics in physics—there's a law which says, unfortunately, that nature goes from order to disorder. You know, it's terrible. I remember when we read it, I was 19 or 20 years old, and I said, "What is this?" It's invariably true. I won't go into the proof of it, but it's very simple. If you take a porcelain statue, and you drop it on a stone floor, it smashes to bits. Every time, it will smash to bits. If you take all the bits together in your hand, lift it up and drop it—you can do it a billion times—it will never form the statue again. That's the principle of entropy, going from order to disorder. Nature likes to do that, except for life. Because life seems to work the other way about. You plant a tomato plant in a pot. The pot's got mud in it. If you water it right, give it the right amount of sunshine, it takes out, atom by atom, molecule by molecule, the stuff to make a tomato. It's a miracle, a miracle of chemical engineering, from disorder to order. Physicists have struggled with this for a while, to say does this go against thermal dynamics? It doesn't. It doesn't because of a rather nihilist, sad-sounding philosophy which says even the tomato will go. Of course we know that. So in the long range, the billion year range, yes, we will end up with disorder. It's called the heat death of the universe. Fortunately none of you will see it. But in the short range, life goes the other way. We don't quite know why, and I believe—and I must say, this time not as a physicist but as a pedagogue—I believe the process of education goes the other way. It goes from disorder to order. Temporarily, yes, because we—all of us, this room—we will all go eventually. That's as far as I can get.

Thank you. This is just one person's opinion, but I'm feeling that I'm seeing at our school more children who arrive, year after year, without the ability to write a decent, clear paragraph, much less a two-page paper. Where would the internet fall into that? There are many different forms of communication, but for simple, clear writing, or do you think that's going by the wayside?

Yep, I know exactly what you mean, except that I would change the word writing to saying they have a problem communicating … communicating the idea. Or do they? That, you have to figure out. Is it only a problem with writing, or is it a problem with communicating? I would go this way. If the same child is trying to describe a computer gaming situation to a friend of his, and explaining how to get out of a tight spot there, is his communication as poor at that point as when you asked him to describe a trip to the zoo? In which case, if it is, then the trip to the zoo is a bad example, or that's the error. So what is it that he can't communicate, or she can't communicate? In what medium do they have a problem in

communication? Is it oral? Is it written? Is it video? Is it audio? Is it painting? Is it…? We need more information on that. And I would go so far as to say, that you will not get a case where you'll say, she is bad at all of them. It is not possible to be human and to be bad at all of them. There will be one, somewhere, where she will be good. The question is—and I think education is trying to answer this question—the question is "Do you foster that one that she is good at? Or do you try to pull her up on all the others?" I don't know. I have very mixed feelings about that. At the moment, our system is such that if you are far above the average in mathematics and far below the average in English, then I will do everything possible to improve your English even at the cost of your mathematics, until you are average at both. That's 1920. We have to be really sensitive to that. I wish I could say that we should go one way or the other. I don't know. But coming to this issue of communication, if you're saying is the internet damaging written communication? I don't think there's sufficient proof. There is some rather poor quality research which comes to this conclusion, which I think is a wrong conclusion. It's like a recent news story which some of you may have seen, which said—a very damaging one—which said that Bill Gates and Steve Jobs both sent their children to schools which were technology free. They didn't have *any* technology. I thought it was damaging because parents will read this, and they'll come back to your principal and they'll say, "Why do you have technology? Look at this. Bill Gates and…" But the point is, are Bill Gates and Steve Jobs experts on education? I think the trouble with parents is that every parent seems to be an expert on education. Education is subjective for heaven's sake. You don't think you are an expert on nuclear physics if you're not. So why poor education? And why should you have your theory and impose it on your children without their consent? So communication. Does it hurt written communication? We better check. Is it important, that thing you were trying to test on? Was it really testing for communication? Why is the child weak at that one particular kind of communication? Is it because of a physical or mental problem? Or is it because she doesn't see the sense of it? If it's the latter, then I don't care if she's bad at it or not. If we haven't been able to convince her why she should be good at it, then she will not be good at it. Neither would I. Not too good an answer, but that's as far as I can get.

Hi. You talked about the internet, about it being <u>there</u>, different from <u>here</u>. And a lot is happening these days, and I'm sure you talked about this in your research, social media and there is a distinct feeling that children use the internet to go there and be there, and be somebody else there. And yet when you talk about collaboration, you talk about the here. Where should they be happy, healthy, and useful? How can we help students to be happy, healthy, and useful here, while they're spending their time there?

That's a fantastic question. I'll remember that question if you don't mind. I might quote you. Okay, here and there. But did it not exist before? Was it not? Wasn't there a time that—I remember very distinctly, when my parents and grandparents used to say, "Don't dip your nose into that book 24 hours a day. Come back to reality." Okay, where were we on *Treasure Island*, on *The Last War on Mars*, on Jules Verne's rockets? That medium also could take us *there*, and then our parents would drag us *here*. Where should we be? Well, with respect to the book thing, we should be somewhere in between. We should have—it's not a question of whether we go *there* or whether we come *here*—I think we should have the ability to decide where we want to go and how to come back. Not how much time we spend, but that depends on the child. If the child is spending a lot of time *there*, inside that imaginary world of the internet, and doesn't come back *here* too often, whose fault is that? The internet's? The child's? Or yours? You and me? On the other hand, are there children that never go *there*, never go play any games? Very, very few. But there

are lots of adults, and I've often found them sounding very proud of themselves. "I don't even have a phone." What can I say except, "I feel sorry for you. Try going there." Okay that's it.