

Technology in Education Around the World to What Ends?

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Thank you very much for the invitation. I think that this convening that you have organized now for years – bringing people to talk about how it is that we can use technology to reinvent, to improve education, to expand educational opportunities – is very much needed. And we met at one such convening that we organized on the other side of the street a few years ago. What I'd like to do today is to set the stage for what I hope will be a conversation on what it is that technology has achieved globally with an emphasis in the developing world in terms of expanding educational opportunity, and what is the potential that remains, what has not yet been achieved.

So clearly the rapid development of telecommunication and computing technologies over the last two decades has enabled a wide-ranging global expansion of learning opportunities outside of schools and, in a moment, Lucia is going to talk about some of those, as well as supporting formal education. Now assessing the effectiveness of these developments requires, first, clarity about the purposes that they should serve. Now what I will do is describe an evaluative framework to examine technology-enabled education and then illustrate how that framework could help us think about some of these examples.

It's evident that technology has enabled many educational applications globally, including in the developing world. These include opportunities for learning through games, for learning outside schools in ways not directly related to school curriculum, and also opportunities to learn the school curriculum, to complement what schools do. In preparing for this presentation, I looked at about 400 studies that are available in the academic literature that talk about the use of technology in the developing world. And I was not able to document any of them that is an epidemiological study that says what is the prevalence of the use of these technologies even in large countries. I will be sharing in a moment data that I've collected myself in the country of Brazil. But I was hoping to find comparable things, for at least the major countries, to get some sense of to what extent is technology currently integrated in instruction around the world.

Now my reading of this literature and my observations in travels and work in many countries in the developing world suggests that the technology with the largest reach involves television and is not specifically tied to the school curriculum, but clearly supports the development of knowledge and skills. I'm going to focus my presentation on

the use of technology to support opportunities to learn the intended school curriculum. One of the earliest uses of such technologies dating back to the 1960s involves radio and television to complement the work of schools. Today, for example, Mexico transmits multiple educational programs through satellite which supplements the curriculum through educational TV channels and uses part of this programming to deliver the secondary school curriculum through a modality that supports local monitors with television programming in rural, marginalized schools.

Also in Mexico, the Instituto Tecnológico de Monterrey – and we have one of the leaders here – a multi-campus university, really pioneered the integration of a series of 30 campi throughout Mexico using technology and realizing that way some of the benefits of scale through the use of early on satellite transmissions of lectures and currently, of course, the internet and online instruction. Beyond on radio and television, more recently, the developments in computers, internet, and mobile phones have opened up multi-faceted opportunities for innovation. Indeed, there is a lot of innovation taking place in the developing world enabled by technology. And you talked about some of those innovations yesterday at this conference.

Some of them include, for example, providing students with access to computing devices or with opportunity to access a computing device for some time, either for the purpose of helping them develop technological literacy or to have them figure out how to use those devices. It's been a long time since the One Laptop Per Child set its bold goal to produce very affordable devices as a way to expand this kind of access. That program, and then the accompanying decline in computer prices in the larger industry, have expanded the number of students who have access to those in schools around the world. Every time I'm travelling somewhere, there is a new president or prime minister who wants to announce One Tablet Per Child in their country.

Another use of these innovations includes supporting instruction with computing and telecommunication technologies as done, for example, with the program to teach science that we have been discussing here, that Dick developed and has pioneered. And has done with a national program to introduce technology in schools in Chile, a program called Enlaces, which was launched about two decades ago. Now more recent applications of this type include the development of learning objects to support instruction, very highly produced learning objects using computer animation, for example, as is done by Educomp in India, a private for-profit firm which develops high-quality lessons supported by animations and simulations that teachers access through a SMART Board.

Similar variations of supporting instruction with SMART Boards that allow teachers access to learning objects on the web or in other resources have been implemented in many education systems. The dramatic decline in computer equipment has allowed innovations such as the prototype currently piloted in Ghana by the Open Learning Exchange, which allows teachers to exchange lesson plans and allows teachers and

students access to a library of reading materials using an intranet based on mini-tablets and on a Raspberry Pi computer, which functions as a server of this network.

An extension of these innovations involves allowing students to access learning objects directly as part of their studies in schools or outside. An example is a program implemented by an NGO in India providing students access to mini-lessons presented in DVDs – not on the internet, because there isn't internet in these schools – which students watch in small groups of up to four students, all sharing the same DVD. These lessons pause after short intervals of presentation of content and pose a question to the group of students, which are then to discuss with one another to check for their understanding. If students have any questions, if they can't master the content, they use a mobile phone to call a call center where someone can provide them additional guidance. And the call center calls, in turn, the teacher and provides job-embedded teacher professional development based on the real-time needs from the students.

Another example, of course, of this kind of thing includes the Khan Academy or the MIT Open Learning Initiative 20 years ago, which are examples of open education resources increasingly keyed to curriculum frameworks. I think that for MIT's initiative, it was not until someone had the brilliant idea of developing an interface that connected the AP curriculum of some high school courses to those learning objects that usage of those resources increased exponentially. They became a lot more accessible for students.

Numerous applications have been developed to support teacher professional development and learning communities for teachers and for schools' administrators. They include Teachers TV in Britain, for example. And now, an internet-based resource which presents high-quality teaching practices developed to achieve specific pedagogical goals for a particular content and grade level. So these are micro examples of teaching, of highly produced, high-quality lessons. These video examples, this approach, has been extended to countries such as Thailand using, again, not internet, but using local stations where those lessons are brought in on flash cards, again, to overcome the challenges of access to broadband internet.

Other modalities of technology used to support education involve teacher education through webinars, learning communities, and other forms of distance education enabled by technology. There are large-scale national programs of teacher education in Brazil, for example, which depend principally on online instruction. One of the most active areas of experimentation and innovation these days involves the use of mobile devices. And, in fact, UNESCO's unit for ICT has a very rich catalog of examples on how these are being used around the world.

At the higher education level, there is extensive use of technology. I'd say that if I compare K through 12 and higher ed, it is really at the higher ed that there is more evidence that the industry is being disrupted in any substantive way through the use of technology, more so than the K through 12 level in my judgment. So there's extensive use

of technology at higher ed, both to supplement instruction of traditional students, but also to develop hybrid or fully online programs to serve nontraditional students.

So to sum up, there's no question that there's abundant utilization of technology in education at all levels for a variety of purposes, and that such utilization is accelerating exponentially. Not surprising, because this is just mirroring the exponential development in technology itself and the declines in the costs to access such technology.

Now systematic assessment of how technology is used – to what extent, and with what effect – is a lot less prevalent than I would have hoped. And there is an apparent disconnect between the limited evaluation which exists and the continuous development and adoption of technology. Now, in part, this disconnect can be explained by the fact that the rapid development of technology makes findings based on the technologies of the past, which could mean two years ago, of limited use to inform adoption of innovations based on new technologies.

For example, the possibilities of the network based on Raspberry Pi, which I just described, which has been pilot tested by the Open Learning Exchange in Ghana. What they're evaluating has a relatively limited way to use the research based on even similar approaches developed with microcomputers at much greater cost than they have. So the essential questions of any education policy, really, or program, and consequently of the evaluation of those, are basically who should be educated, for what purpose, with what technology, in what way, at what cost, and who should pay. And these six vectors are absolutely interdependent. They form a system. So if you change the position of a technology in one of those vectors – say, cost – the entire equation changes.

So if there is evident and growing use of, and adoption of, technology for education purposes in many schools around the world, it's less evident that such adoption is yet systematically transforming the education enterprise. Now that may be a matter of what time scale one uses to judge that. If we measure change in centuries, or perhaps even decades, there is a fair amount of change. If we use a more compressed time scale, things are changing much more slowly than technology suggests would be possible.

There is no question that, theoretically, technology allows the development of innovations which can be absolutely transformative, disruptive. The examples I have presented are all potentially disruptive. And this is to use Christensen's notion of disruption. They allow the delivery of higher-quality education to an under-served market with a solution that is not excellent, but good enough, at such low cost that increasing adoption should be expected. But I don't see evidence that adoption is taking place at a scale that visibly transforms the functioning of most schools, of the entirety of those systems. I'm going to illustrate these with some data that I collected in the past several months ago in a survey that I administered to a sample of school principals in Brazil.

I've been for the last four years collaborating with a public university in Brazil in the development of a program to develop education leaders. From school principals to other people who work with them, these are people who hold full-time jobs. This is a blended program, 80% of this online. I can tell you that the uses that my colleagues in Brazil make of technology, of actually open resources, are a lot more creative than the uses I have seen in our own community. So that supports the point there is a lot of innovation taking place. This program would have been impossible absent Moodle, which is the basic platform they use to offer these distant courses, for example.

So I asked these principals a few questions to get some sense – and these are 300 principals from five Brazilian states. They all work in public schools. Let's call them typical states. They're not the poorest states in Brazil. They're not the wealthiest states in Brazil. And I wanted to get a sense of how technology is integrated in instruction in their schools. And this is what I found. I apologize that the slides are in Portuguese. The title is at the top. So I asked them, is there a plan to integrate technology with teaching in your school? Do you have a strategy? And what you find is that 41% of them do have a plan. This is great. But about 60% percent of them don't.

Now this is such an obvious thing to expect of an organization, that if you're going to bring this technology, you put together a little committee that would include faculty and others and say, what are we going to try to accomplish with this technology? How is this going to tie with the instructional mission of this school? And that so many schools, in a country that has made massive investments in technology in school as Brazil has done, that three in five principals report that in their schools there is no strategy is indicative of the point I was making earlier, that we have yet to see the disruption of most schools.

I asked them, is technology used in your school to support student learning? And what you see on the left-hand side, the two columns, is not all – the extreme one – and "pouco" means very little. So in about half of the schools, technology is not used to support student learning. It's used mostly to support administrative functioning of the school. I asked these principals, is technology supporting innovative forms of teaching and learning? And, as we would expect, the number of principals who say very little or not at all increases to 60% here.

I asked them what percentage of the students have frequent access to technology in the school. And, again, 47% of the principals say very little access to technology in the schools. Now this is a country where mobile penetration is over 95%. And so think about the disconnect between the experience of the students outside the school and the experience of the encounter when they come into the school where half of them do not have frequent interaction with technology. Is technology used for a very simple function? I was hoping to see that they were using emails, text messenger systems, something to communicate with parents. It's a big priority in Brazil, developing good relationships or good communication between schools, school communities, and parents. And again 83% of the principals say we don't use it for that purpose.

Are there platforms, learning management systems, used to support course development, the kinds of things that have become fairly widespread at the higher education level? Again, here, over 70% of them do not use any kind of learning management system, course platform, to support instruction. Are technological platforms used to support the work of students? Digital portfolios, for example. 80% report that very rarely do they use that. In your school, are platforms used to support teacher collaboration? Something as simple as a blog, a threaded discussion, Google Docs where people can collaborate. And, again, 75% say no, we don't use such things. Now, remember, these are technologies where the only cost is the cost of accessing the internet. There is no cost to many of these software platforms.

So if I see this happening in Brazil, which is a country where education is on the agenda, has been on the agenda for the last two decades, where the country has made substantial investments in education, including investments in technology and to bring technologies in schools, I think if there's a country one could have expected, a country of a reasonable scale, to see technology disrupt education, it would have been Brazil. This is not a country that has just recently discovered that education was important. So, to some extent, I think this is illustrative of the challenge.

Now if one were to look for specific small-scale innovations, even municipal innovations, there is plenty to celebrate. There are very creative things happening in Brazil. This program to develop school leaders that has been developed largely by a public university in Brazil is, in my mind, a very good practice, both in terms of how to think about providing job-embedded training for people who are in those positions and how to use creatively low-cost technology to make possible a connection between the university and the world of practice. But I don't see similar things on a large scale at the K through 12 level yet.

So what these figures show is that the introduction of technology in schools doesn't appear to follow a design, a clear strategy to transform education. It's an add-on often lacking a clear education vision. There are many obvious missed opportunities in the responses I have just shown you from principals about how technology is being introduced in their schools. The main missed opportunity in my mind is that the vast majority of the innovations supported by technology of which I am aware – and I spent a lot of time reading the catalog developed by UNESCO of all these applications of mobile technologies, which is where I expected to see the greatest breakthroughs – the main missed opportunity is that most of these are focused on improving access or the efficiency of educational institutions in achieving the goals of the past, in teaching the basic literacies, a narrow set of goals when, in fact, these technologies have the potential to help educational institutions achieve a much more ambitious set of goals, a 21st century conception of learning and teaching.

The National Research Council released about a year ago a report that summarizes what we know about 21st century skills and provided a very helpful taxonomy, which I think

could inform a framework to both design innovations that can disrupt education and evaluate them. In fact, such framework was used by a group that convened at this university in January, convened by your chancellor and by my colleague Chris Dede, looking at the impact of technology in higher education itself. They were thinking mostly about MOOCs and about higher education largely. And their report was just released. And it did exactly what I'm suggesting. It took the National Academy of Sciences' framework on 21st century skills and said, what would an evaluative approach, informed by those goals for learning, look like?

So I want to show you very quickly what the National Academy does, which is to identify the competencies that matter in the 21st century, in three buckets – cognitive skills, the capacity to work with other people, and the capacity to govern oneself. And for each of those buckets of competencies, there is a body of scientific research based on learning sciences, on psychology developed over the last centuries that could very well inform a deliberate strategy to disrupt education using technology. So what are some of those buckets, basically?

Cognitive skills involve processing and cognitive strategies, knowledge, and creativity. Knowledge is where most of the applications I have seen is currently focused. It's not that knowledge is unimportant. It's that if it is the only thing that we concentrate on, we're going to serve the kids very poorly to have the skills that will allow them to use what they know to solve problems.

Processing and cognitive strategies, the best educational innovations do that. Many large public education systems are still struggling with trying to achieve these at scale. Critical thinking, problem solving, analysis, logical reasoning, interpretation, decision making, and executive functioning – a skill that we know is increasingly important, the ability to organize yourself and to stay on time when you're given 20 minutes for your presentation. I need just one more minute.

Knowledge, this is what most education systems do. Creativity, increasingly, we're paying attention to the capacity. I see in just about every university – certainly in mine, I hope you do it in yours as well, Dick – we have all of these innovations in pedagogy to support new forms of learning for students. Presidential competitions where students are invited to tackle big challenges using what they know in teams. We have created an innovation lab to do that. I teach a course on educational innovation and social entrepreneurship, where the pedagogy is all based on project-based learning – get the students to solve real problems. So this is increasingly receiving attention in some educational institutions.

Interpersonal skills, basically, the capacity to work with other people – fundamental to live in the 21st century – and the capacity to lead others. And modern technologies have given us unprecedented opportunities to help students develop those capacities to work in social networks of other individuals. But I have yet to see at scale examples of

innovations designed to do that rather than to help remediate or address the most basic skills. And, lastly, the capacity to govern oneself, to develop the ability to learn, work ethic, and to be self-efficacious.

In my mind, these are the opportunities of the coming decades, to use technologies to create opportunities to develop those skills, to use this approach in engineering those technologies and in evaluating them. But the challenge will continue to be that because technology develops exponentially much faster than we are developing educational applications, and because the costs are also dropping very, very rapidly, research is always going to be playing a catch-up game in generating findings that have some use to inform future programming decisions.

Thank you very much.