Technology for learning: New ways of seeing and doing things

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As a scientist who examines the science of learning in the context of technological advances, I am frequently asked the following: How will technology change the way we live and work? How do we prepare our students for such a future? What role could technology play in such preparation?

If history is anything to go by, technology tends to disrupt human practice in significant ways. From the invention of the wheel to that of paper, from printing press to television, from the steam engine to the internet, technology has always had a significant influence on how we see things, connect with each other, how we learn and work, what we value, and what it means to be human.

Unsparingly and unsurprisingly, advances in modern technology stand to do just that. I outline five major ways.

First, technology will continue to open up new ways of seeing things. We can now visualize and simulate complex phenomenon like never before. Whether you are looking at nanoparticles, intermolecular forces, or emergent behaviors of dynamic networks. Advances in Virtual Reality and Augmented Reality that allow us to immerse ourselves in worlds and experience the world or alternative worlds in ways, if well designed, can be highly productive for learning.

Second, technology will continue to change the way we connect with each other. On the one hand, it opens up access to knowledge and expertise. You can pretty much access all codified knowledge on the Internet. You can listen to, and perhaps if you enroll in an online course, interact with the top experts in any area. On the other hand, the same ease with which we gain access has the danger of isolating us. An over-emphasis on the online connection can create an illusion of collaboration, and result in psychological isolation.

Third, technology will increasingly personalize learning. One size does not have to fit all, and it will not. Advances in machine learning and artificial intelligence will allow us to design systems that adapt to individual learning progressions. And when these systems embody the latest research on the science of learning, the potential for powerful learning is immense.

Fourth, technology will allow us to situate learning in disciplinary practice. For example, if you are training to become a doctor, then instead of waiting till internship to engage in clinical practice, technology will allow you to engage in clinical practice in artificial worlds that will increasingly resemble real-world situations.

Situating learning in authentic contexts has the added benefit of coupling explicit and tacit knowledge required for the development of expertise. Explicit knowledge is knowledge that can be externalized, represented, codified, and communicated. Laws, principles, theorems, formalisms are examples of explicit knowledge. You can read it in books, listen to lectures, and talk to experts. Tacit knowledge is something that cannot be externalized, let alone be codified or communicated. You can't read it in books, listen to a lecture, or ask an expert even.

Research on expertise shows that it is not just explicit knowledge that experts have. Rather it is the tight coupling of the explicit and tacit that makes for high expertise. Advances in technology will play a significant role in affording the design of powerful learning environments that couple the explicit with tacit, thereby engendering deep learning.

Fifth, the technology will also force us to focus increasingly on critical thinking, synthesis, and sense making. The democratization of information has made the role of critical evaluation of easily available information even greater. Schooling will need to redouble their efforts in developing critical

thinking. Concomitantly, how does one learn to take all that information in and make sense of it, whilst evaluating each bit critically? The need for synthesis and sense making skills will be needed more than ever.

I wrap up with another question that people often ask: Will technology replace teachers?

My response is simple. To the extent that teaching focuses mainly on the transmission of explicit knowledge, machines can probably do it better. To the extent that teaching focuses only or mainly on simple facts and procedures, machines can probably do it better. To the extent that teaching focuses mainly on the individual learner, machines will probably be able to personalize learning better.

What we need is for teaching to focus on both the individual as well as the social, basic content as well as critical thinking and sense making skills, and explicit as well as tacit knowledge. In other words, teaching will have to re-focus on what it means to be an "educated" human being, in the fullest sense of the word.

Such a re-focus will require collaboration between multiple stakeholders—learning scientists, technologists, educators, policy makers, philosophers, ethicists, and so on, as well as the public at large.

Instead of viewing technology as a threat, as something that might disrupt or replace us, I see a transformative opportunity for a most promising paradox where we can thrive alongside technology. That is, advances in technology may give us no choice but to re-focus on what makes us human.

And that is our niche that cannot be replaced.