Gender, science and technology: the sustainability gap

Kabir Shaikh

We live in interesting times. Think of the whole world witnessing the historic events in Egypt and Tunisia that led to transfers of power; the floods and the fires in Australia; the web-based mobilisation of a successful 'Save our Forests' movement in the UK; and the women's movement in Italy that questioned the moral behaviour of a political and media giant. Curiously, all were interlinked. These were strong and vivid illustrations of the power of technology, the effect of climate change, the urge to preserve the environment, and the fight to protect and respect the rights and dignity of women. They also have an intrinsic connection to the subject of this paper: where next for science, technology and maths education in the Commonwealth – and women's roles in it?

The context

The Commonwealth is, in essence, a third of the global population struggling to fight the challenges of poverty; gender inequality; lack of resources; serious health issues; and climate change. The recurring priorities identified by the Commonwealth Heads of Government Meetings are a clear recognition that these issues need addressing.

The conclusions are rather more straightforward, however. Firstly, we need to generate more food, conserve more water, produce more and alternative energy, control populations, and protect the environment to avoid climate change derailing all our efforts. This, of course, does not include the disasters that humans themselves inflict on humanity through wars, conflicts, terrorism and greed.

Secondly, science, technology and maths (STM) are at the heart of each of these eventualities, either in creating a solution or in the mitigation of a disaster.

In short, we need a society where there is a strong and competent community of scientists, technologists and mathematicians who can collectively address the complex and multiple challenges through new and different solutions, using innovation, creativity, discoveries and inventions. We also need a society that is STM literate to appreciate and partake in the collective response to the challenges, and one that can contribute to generating more wealth and to the economic well-being of the nations.

The link between the number of technologists and researchers a country produces per million of its population and its economic affluence is clear. It is also interesting to note the contribution or involvement of women in the research enterprise. There is a huge gender gap between the men and women in the field of STM, and consequently a deficit in the wealth-creation process and a missed opportunity for capitalising on nearly half of the world's active, intelligent and creative workforce.

The challenges

Much work has been undertaken to investigate issues related to STM education, girls in STM in particular and the overall enthusiasm for STM for its potential students and career aspirants. The European Commission and other various bodies have commissioned reports, the conclusions of which are all rather straightforward, but the solutions are not. They pose the challenge of accepting that:

- STM education and STM careers need to be made more attractive and accessible, to girls in particular but to all students on the whole.
- The content, approach and delivery of STM education have to change radically.
- STM needs to be for all, and must continue beyond secondary level; this will require a massive increase in the number of STM trained teachers and their quality. This also means a massive increase in the demand for STM graduates for higher education establishments and their capacity to meet such demands.

The response

If we were to respond to these highly resource-intensive challenges, we have to think of alternatives that are based on the technology. After all, other sectors – the media, the advertisers, the industries, the health organisations, the agriculture – have all capitalised on the technology revolution. Education has been left behind a little, and we have some catching up to do.

The first prerequisite to the response is making STM more attractive and relevant to its learners, and girls in particular. The curriculum has to be made more accessible through the applications of science and maths – i.e. the technology leading into these subjects rather than the other way round. The applications should lead to the understanding of basic ideas and the manipulation of those ideas. This is an entirely reverse process to the one we have used so far.

Take a triangle whose base corners are science (the basic ideas) and mathematics (the manipulation), and whose top corner is technology (applications as a result of manipulation of basic ideas). This triangle represents the traditional model for how science, mathematics and technology have been traditionally taught. I am

suggesting that we now look at a curriculum model that is represented by this same triangle, but turned upside down.

There is ample evidence that today the technology precedes the learning. The use of a mobile phone, a PC and the internet to gather, interpret and use information to achieve results has collapsed the steps of the logical ladder of ideas, manipulation and application. This is a new paradigm – a completely new way of constructing and delivering an STM curriculum. We have all seen children multitasking by holding a conversation while sending a text message in a language that has self-evolved in its grammar to make it cheaper. In India, I have come across many people who do not know English but have learned the alphabet to be able to send messages in their own language but written in English.

Evidence points to the fact that girls are more engaged with STM if they can identify with the practical aspect of its application to solving a day-to-day problem or its link with a problem that is visible. Climate change, the environment, alternative resources to generate energy, self-generated learning through the use of IT, connecting with people, and addressing issues related to population growth and health should all provide enough basis for creating a new curriculum that is technology based.

It is also important that while creating this new curriculum, STM is treated as an integrated curriculum rather than having the traditional maths, science and IT as separate subjects. It is for educational thinkers, researchers and planners to look into this aspect and to design a new curriculum. It then follows that we create a new cadre of teachers who are themselves trained in an integrated STM curriculum and who know how to deliver it effectively.

This is a tall order, but will it work? And how will it work? The high cost of higher education, the availability of disproportionately small places, and the drive for fewer but better graduates makes it all unthinkable.

The curriculum and the pedagogy

Professor Sugata Mitra (the Indian Slumdog academic) argues that technology is a great motivation for STM learning and self-learning. The acquisition of basic computing by any set of children can be achieved through incidental learning, provided learners are given access to suitable computing facilities with entertaining and motivating content and some minimal guidance. Indeed, Mitra argues that education technology is more effective in underprivileged schools.

His 'Hole in the Wall' experiment with the slum children in Delhi produced some astonishing results. It took the children just eight minutes to access the internet on a computer that they had neither seen nor touched before. Within eight days, they could understand nearly 200 words, such as *exit*, *stop*, *file* etc, without any previous knowledge of English, and were helping each other to access websites and play games. Both peer-group learning and self-generated learning leadership were visible, alongside a self-discipline. Mitra argues that learning is a self-organising system that can flourish given the right opportunities through the advent of technology. Children driven by their intrinsic motivation and a strong sense of natural curiosity can be willing and enthusiastic practitioners of the self-learning approach.

Photo: Commonwealth Secretariat/Rebecca Nduku

A Muslim school, East Africa

Mitra also argues that we need an education technology. Until now, we have used or borrowed technology created for other users and for other purposes. But what we need is a technology specifically created, designed and produced for education – in his words, "An education technology and pedagogy that is digital, automatic, fault tolerant, minimally invasive, connected and self-organised."

A new imaginative workforce

What we need is a well-qualified, well-trained, creative and imaginative workforce who will deliver a curriculum where the science and maths are integrated and relevant, and involve local, practical, environmental and climate-related problems. And we need these experts in sufficiently large numbers to meet the population demands. But is this possible with the crippling costs of higher education, the limited places and the quality prerogative?

Using open and distance learning

Sir John Daniel – one of the most inspiring, innovative, practical and persuasive educationists of our time – argues that by combining the traditional benefits of the industrial revolution and the newer acquisitions of the technology revolution, we can make the 'iron triangle' of access, quality and costs more flexible.

The Industrial Revolution brought with it the benefits of division of labour, specialisation and economies of scale. Mass production can result in a high quality product at low cost, making it available to everyone who desires it – that is access. We are seeing that in our everyday lives – the cars, the iPods, the mobile phones, the digital cameras. In education, we look to mass production for high quality learning materials, videos, prints, audio books and software at an affordable price. Mobile phones, the internet, emails – all can support an effective programme of independent and supported learning. This is the open and distance learning (ODL) approach that is now becoming one of the fastest modes of learning for adults in the Commonwealth. Given the right parameters and specifications, ODL can create a programme specifically designed to train and re-train teachers in an integrated STM curriculum. It can

provide initial teacher training as well as create a network of teachers for ongoing support.

Furthermore, ODL can deliver the mass numbers of STM graduates we will need over the coming decades to respond to the challenges of economic and industrial development in Commonwealth countries. So, in effect, we do have the technology that can make change possible and allow us to think the unthinkable.

However, there is still the issue of mobilising societies and communities into understanding the critical roles of STM in wealth creation and in generating solutions to global challenges. And it is the governments who must take the lead in that process in addition to making STM a priority for national development.

We have the new technology and a great sorority of educational and STM thinkers, researchers and creators. We must dare ahead! There cannot be any going back, unless, as W. Edwards Deming said, "It is not necessary to change. Survival is not mandatory."

Endnote

[1] Adapted from the author's Dennis Chisman Memorial Lecture, *Where next for Science, Technology and Maths Education in the Commonwealth?* delivered at the Commonwealth Association of Science, Technology and Mathematics Educators (CASTME), London, 16 February 2011

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