



STEM EDUCATION

We need an ideological revolution

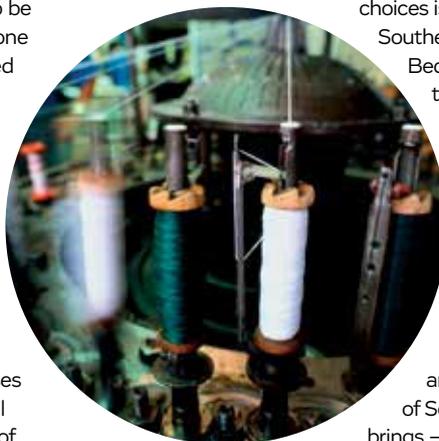
How to ensure exceptional science and maths education, which is vital for the country's economic development.

Innovation is the bedrock of a prosperous economy. Consider the Spinning Jenny, invented by James Hargreaves in 1764. It was a simple technology that allowed predominantly women and children to be far more productive in producing yarn: instead of one spinner at a time, the Spinning Jenny allowed a spinner to work eight spools at once. Further developments increased this number to 120. (Today's equivalent would probably be your colleague showing you a code that suddenly reduces hours of manual data work to the instantaneous press of a single key.) It's quite obvious that one of the most fundamental questions in economics must be about how society encourages innovations like the Spinning Jenny (or your colleague's software programme).

Staying with the Industrial Revolution: The causes of this remarkable upswing in human prosperity will probably be debated forever, but a new generation of economic historians suggests it wasn't the classic factors of production that we typically associate with growth: access to cheap resources (although that was necessary, but not sufficient), high levels of skills (again, necessary but not sufficient) or trade. King's College London PhD student Anton Howes suggests that an ideology of innovation made the difference. He defines this ideology as a combination of the mentality of improvement (British men trying to improve everything they encounter, from spinning yarn to writing love letters) and the commitment to advancing improvement (an "almost universally-held commitment to spreading and diffusing innovation"). A crowd of 18th-century Elon Musks.

Innovations are, of course, becoming increasingly technical. But not everyone has access to robotics, nanotechnology or laboratories needed to invent the next big thing. And even if we did, we'd need years of training. A new paper in the *Review of Economics and Statistics* by two Finnish economists shows science, technology, engineering and maths (STEM) education is critical in producing innovators. They use a novel technique (the distance Finns live to the nearest technical university) to show that better access to universities – but especially universities offering engineering degrees – is essential for generating new patents, and thus innovations. They calculate that three new technical universities resulted in a 20% increase in Finnish patents, boosting technological innovation, growth and living standards.

Much has been written about the affordability of universities in SA. In a research paper I co-authored with Estian Calitz, we show, for example, that the costs of tertiary education is today nearly three times higher than in the 1960s. Even so, demand outweighs supply and many



The Spinning Jenny was invented by James Hargreaves in 1764, an innovation that increased the production of yarn.

students are turned away at university gates. Those that do enter often base their choice of career on their experiences at school or their friends' opinions. Evidence of uninformed choices is provided in a paper by Economic Research

Southern Africa's (ERSA's) deputy director Biniam Bedasso. He shows that black students at UCT tend to choose less mathematical courses in contrast to their white peers (controlling for a host of covariates) because of the poor quality of maths at high school and because few of their friends choose STEM degrees. White students with similar high school marks as the black students are therefore more likely to follow STEM courses.

This preference for non-STEM courses by our brightest black students is worrying. It means the ideology of innovation will be limited to a tiny and unrepresentative slice of the next generation of South Africans. And the benefits that innovation brings – for example, selling a ground-breaking patent to a commercial entity – will be limited to a few, further exacerbating inequality.

What to do? It's easy to say we need better maths and science teachers and resources in high schools, but for many reasons this is incredibly difficult to achieve. My advice would be to build them from scratch: **imagine the impact of 50 fully equipped, state-of-the-art technological schools that each provide free tuition** (and accommodation) to 500 kids in rural areas, of which 100 matriculate each year. Attract excellent teachers by paying them well. The 5 000 kids who annually graduate from these schools with top marks in maths and science should be fast-tracked into SA's top universities and, if possible, sponsored to study at the world's best universities. The success of these role models will inspire others in their communities to pursue a career in maths and science.

Obviously more can be done to expand STEM capacity at universities too. #FeesMustFall may be too expensive in the current fiscal climate, but what about #STEMFeesMustFall, at least for those unable to afford them? Creative incentives to attract skilled innovators and entrepreneurs from abroad, to support the development and commercialisation of new patents, and to open export markets for these products and services should also be considered.

The success of SA's future economy depends on us producing the scientists and engineers that can replicate existing technologies and innovate new ones for the local context. The ideological revolution we most desperately need is the one that exalts innovators as the revolutionaries of our age. Our collective economic freedom depends on it. ■

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