Mathematics education in the UK does not add up

Ian Benson

Upskilling and reskilling have become buzzwords in the debate over challenges facing the UK. One CBI report suggests that, by 2030, more than 30mn people will need to be reskilled. The question is how to do it. And the answer lies with mathematics. Mathematically educated people are akin to the stem cells of a technologically advanced society; they can retrain themselves quickly as needed, stepping into new roles and managing new crises as these arise. Their training and continued professional development are thus matters of national significance. Informatics, what many call computer science, is mathematics' modern — and equally crucial — companion.

Mathematical thinking may be applied to many (seemingly) non-mathematical situations, for example by technicians operating energy networks who need to be able to build mental images of big complex systems and use them when working with real systems.

The discipline necessitates reverse thinking, understanding conceptual models rather than simply following algorithms and cultivating the ability to see the field, rather than just the ball. It means looking at both sides of a project: how its aims could be achieved, but also where and why it could fail — and what to do in this situation. Above all, abstract thinking is an ability to remove all the unnecessary details. Unfortunately, mathematics education in Britain is effectively losing the ability for such abstract thinking. In the mid-20th

> Geometry has been cut while trigonometry has largely disappeared, and nothing has replaced them

century, these capacities were developed in school through the study of very long, complex systems of proofs in Euclidian geometry, and sophisticated and tricky proofs of trigonometric identities. There is nothing now of comparable complexity. Elementary calculus, once taught in the context of physics, is presented as isolated procedures. Geometry has been cut while trigonometry has essentially disappeared, and nothing has replaced them. There is little training today to develop theorem-proving skills in mathematics.

The need for wider and deeper involvement of people with serious education and skills in mathematics and informatics has been recognised by the government. Mathematics schools, largely inspired by the Russian institutions, were announced by the Conservative-Lib Dem coalition in 2011. These make a welcome contribution, but they fall well short of their potential.

Mathematical education is also held back by the testing-and-examination-focused school accountability regime, and by a disciplinary focus that fails to exploit the symbiosis between mathematics and informatics. There needs to be a continuing mechanism for keeping education in this area up to date — particularly with school mathematics and computer science. These subjects should probably be taught as one.

Since the enterprises (and public services) that will employ tomorrow's workers may not yet exist, the onus is inevitably on education to prepare students to think for themselves. This should start with mathematics. The responsibility for articulating and providing those future skills lies with schools and universities.

Current initiatives lack intellectual ambition. In particular there needs to be a closer working relationship between universities (where mathematics and computer science often advance at world-class levels) and schools (which lags some 20-50 years behind).

The UK needs a national programme of university-led outreach classrooms in schools. These should replace the specialist mathematics schools initiative, which has failed to scale, and the cautious mathematics and computer science teacher professional development programmes. Otherwise these vital skills will continue to languish and the country will continue to underdeliver on its potential.

The writer is a visiting scholar at Stanford Graduate School of Education