Practical science has a global reach and appeal

As English schools consider downgrading practical science, John Baruch points out that other nations are rushing to include more.

England has a bizarre plan to downgrade the importance of practical science in schools. A consultation just closed by the Office of Qualifications and Examinations Regulation suggests that practical science and laboratory work should no longer contribute to the final mark for the A-level examination that students take at 18.

The move is especially odd given that other nations — Britain's competitors — are waking up to the need to include more practical science in their education systems. And British scientists are helping them to do it. I am one of them.

These countries — China, Poland and Ireland among them — realize that practical work is not just an integral part of science and essential to understand how science works, it is the best route to give students the skills they will need to support technological innovation. China, especially, has ambitious plans here: officials are working to change the culture of its school system so that it recognizes and rewards practical skills.

Practical science is more than hands-on science. It challenges the student to understand the real world, to create ways to test that understanding and to grasp the significance of statistics and errors in their arguments.

I am an astronomer, and my subject has a major advantage when it comes to practical and hands-on experience. We can automate and offer it remotely. At a stroke, this solves one of the obstacles to practical science in schools across the world: that lab work is expensive and requires skilled teachers and laboratory technicians, which are in short supply. Practical astronomy is easier — given the right equipment.

The Universe travels over our heads every night, and the only requirement for practical work is a telescope. In the late 1980s, the UK astronomical community, tired of the tedious need to guide these large instruments by eye, decided to investigate robotic telescopes. I was awarded a research contract to prove the concept of a telescope that could work autonomously.

The result was the Bradford Robotic Telescope (BRT). Initially perched high in the Yorkshire Pennines, it was the world's first fully automated instrument. Users submitted a list of objects they wished to observe and waited for the results to be returned to them by e-mail. Astronomers had priority, but the early years of the Internet allowed us to open up its use to thousands of others. We gave them free access to the instrument when the astronomers were not using it.

The telescope was then transferred to Mount Teide in the Canary Islands. It does everything for users: evaluates the weather, schedules itself to optimize observations, takes calibration data and returns the whole package along with analysis programmes. This is now an option on nearly all large telescopes, but for

members of the public it remains unusual. (The norm is for users to have a fixed time slot of half an hour or so to drive the telescope, using web cameras at the observatory to see whether the weather is suitable and to move the telescope to point at the object they want to observe.)

Around 90,000 students and 2,500 teachers in Britain use the BRT. Secondary schools pay £195 (US\$326) a year; primary schools £70. Every child has a username and can log on from home. More than one-third do so, and the results are stunning: children race back to school the next day to tell their teachers what they found.

In many schools, the telescope forms part of the GCSE astronomy programme (taken at around age 15), and astrophysics modules of the physics A level — one of the subjects for which officials are now trying to downgrade practical experience.

Britain's loss could be China's gain. China has traditionally shown little interest in practical science in schools. Practical work does not feature in the school-leaving, or *Gaokao*, examination — the most important exam taken by Chinese young people (when they are 17) — so students, parents and teachers have never taken it very seriously.

That is now changing. A pilot programme run in the Beijing region and led by the Chen Jing Lun school will see practical-science projects contribute. The BRT will be the lead project offered to the students, starting this spring term. The British Council — which promotes international educational opportunities and cultural relations — has helped us to translate our website into Chinese.

Assuming that the pilot succeeds, there are already plans to expand it. We are talking to the Chinese Academy of Sciences about how it could

build its own robotic telescopes. The Beijing Planetarium, Tsinghua University and the South China University of Technology in Guangzhou are already working on ways to give all Chinese students access to them.

There is interest elsewhere, too. Ireland ran a very successful pilot programme last year through University College Dublin and is now looking at how to roll it out across all secondary schools in Ireland. A pilot in Opole, Poland, organized through the University of Warsaw's physics department has the same objectives. All these international developments are driven by an aspiration to build technology-driven knowledge economies with high-paying employment.

The skills of innovation and creativity developed with practical science are the bedrock of a knowledge economy, and the Chinese and others using UK technology to boost their competitiveness must be looking at England's plans to drop practical science at A level as rather strange.

John Baruch is a senior lecturer at the University of Bradford and visiting professor at South China University of Technology in Guangzhou. e-mail: john@telescope.org

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