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Regulars

Pluschat



Help us to help maths



Maths is for nerds?

Mathematics in the UK is in a crisis. The number of those taking A level maths is on the decrease and there are not enough maths graduates to meet the demand of industry and the academic world. This isn't news to those working in the field. In fact, in the last issue of *Plus* (see [Where's the next generation?](#)) we reported on the UK Mathematics Foundation's gloomy predictions for the future.

The problem seems to be the enormous conflict between what maths is perceived to be – boring and irrelevant – and what it actually is – highly applicable, highly valued by industry and at the cutting edge of science. This

negative image of maths creates a vicious circle: it puts young people off studying maths at university, creating a lack of inspiring and informed teachers and role models, which in turn promotes the negative image.

But how can this cycle be broken? What other causes are there? These are some of the questions discussed at a workshop *Plus* attended recently, part of the HEFCE (Higher Education Funding Council for England) funded project, "[Increasing the Supply of Mathematical Sciences Graduates](#)". The project is working with teachers, academics and representatives from industry to come up with a fully costed strategy to tackle declining numbers of maths students by February 2006. The workshop raised many interesting points, and *Plus* has tried to consider what we can do to help. But what do you think?

Schools

"Uninspiring teachers" receive the bulk of the blame for students dropping maths, but it would be grossly unfair to turn teachers into scapegoats. Even the most motivated teacher only has a finite amount of time and energy. Often essential parts of the job, like finding interesting teaching resources and initiatives, have to be squeezed into the teacher's limited spare time. Instead, many teachers feel forced to spend more and more of their time dealing with administration, and that they must teach only for exams to do well in government evaluations and league tables.

But teachers can only inspire their students if they themselves are inspired about their subject. One answer is to offer teachers "sabbaticals"; periods in which they don't have to teach, so that they can refresh their links with the wider maths community and learn about new developments, applications and careers using maths. However, any such scheme could not be implemented until the current problem of a lack of maths teachers is resolved.



Maths is boring?

We are told time and again that what motivates young people to do maths are its applications and career prospects. But is this always true? Many mathematicians say that what fascinates them about maths is the beauty of the ideas, and the fact that, in some sense, doing maths is a quest for "truth", closely connected to philosophy. We need to recognise that different sides of the subject will inspire different students to do maths. There needs to be a balance in teaching, between the practical aspects and the philosophical and aesthetic aspects of the subject, in order to encourage the greatest number of students to continue studying maths.

Not all students will want to study mathematics for itself, and intend to go on to study other subjects at school or university. Maths is the language of all the natural sciences, it gets used extensively in the social sciences and has a rightful place in the visual arts, music and philosophy. Is this message being brought across, or is maths being squeezed out of syllabi, for fear that students get put off by it? Should maths be re-injected into other subjects?

A recent study showed that a worrying proportion of A level students who want to go on to study subjects such as physics or economics, were not aware that they will need some very advanced maths. The responsibility of improving students' awareness does not fall on teachers alone: careers advisers are very important agents, too. Anecdotal evidence suggests that many careers advisers are ill-informed about the job opportunities open to maths graduates. It is essential that they receive comprehensive training, and this is not only down to their training bodies, but also to employers and the mathematical community as a whole.

Universities

If teaching style and content is seen as a turn off in schools, it is considered even more of a problem for mathematics students at university. Research is the name of the game in universities. Lecturers are under immense pressure to compete internationally and do well in research assessment exercises. They are also increasingly required to perform administration tasks, leaving them little time for their research let alone teaching. In this atmosphere, teaching can fall by the wayside.



Chalk and talk?

In some maths departments, budding lecturers (such as PhD students and postdoctoral researchers) receive no training to prepare them for their lecturing roles. A lot of university teaching follows a "chalk and talk" approach that some people find old-fashioned. The big picture applications and cultural context is often kept out of lectures. Is injecting more money into the system, freeing lecturers from their administration roles and offering training, enough to improve the quality of teaching at universities? Some people believe a more fundamental cultural change is necessary elevating the profile of teaching within these institutions and exploring new and innovative ways of teaching.

But mathematical research is not only an important part for researchers and universities, it could also attract students into the subject. Many people do not know what maths at university is all about. If you tell someone at a party that you are a maths researcher, the answer "But I thought that all the maths there is has already been worked out" is all too common. In reality, research in maths is extremely vibrant, and many mathematicians work with other scientists at the cutting edge of medicine, physics and other areas. Maths undergraduates are often taught by world class scientists. Ambassador schemes like the UAS and STIMULUS, which send undergraduates into schools, have proved a great success in sharing their experience of university level maths. Extending these schemes, and more co-operation between schools and universities could help give students a better idea of what it's like to study maths at university.

But researchers, particularly those who receive public funding, have their own part to play. They should take on some of the responsibility of raising awareness of maths in the community, and attempt to communicate their research at some level to the general public. Getting the public, and particularly students, excited about current research in the subject, by explaining the mathematics itself or its possible applications, would be a huge step in changing their perceptions of the subject and attracting more maths students.

Employers

In recent years some maths departments have been forced to abandon employment specific maths courses, such as "statistics for the pharmaceutical sector", because of a lack of students. Yet employers value these courses highly as they turn out well-prepared graduates. In fact there have been bitter complaints from employers about the lack of mathematically skilled graduates, and this shortage must be addressed if they are not going to turn to importing expertise from outside the UK.

Employers know best what kind of people they need and what they need them for. If they worked more closely with schools and universities, for example through open days or by sending young professionals into schools to give talks, employers could help make students, teachers and careers advisers aware of the variety of career paths that maths opens up.

Government

The government seems to be aware of the problem, and projects like "Increasing the Supply of Mathematical Sciences Graduates" are a start. But many people are looking for more concrete actions. Funding is, of course, one of the main issues that fall within the government's remit, and many of the points raised in the other sections do depend on money. Perhaps universities should receive sufficient funding to run employment specific courses, such as "statistics for the pharmaceutical sector", regardless of uptake. More money would also enable schools and universities to employ administrative staff to lift teachers' and lecturers' work load. Some funding has been provided in the shape of financial incentives for people to become maths teachers. But do they work, or do they draw people into the profession for all the wrong reasons?

Quality control is an equally contentious issue. League tables based on exam results are considered by many too crude a measure of an institution's performance. Ofsted inspections have been known to leave some teachers on the brink of a nervous breakdown, and surely that must be counterproductive. Perhaps the government needs to fine tune its methods of evaluation.

Parents and the general public



Parents have an enormous influence on students' perception of what they learn at school. According to teachers, parents often reinforce their children's negative attitude to maths: if they themselves hated it at school, then they don't want to inflict it on their kids. Some parents don't think that bad grades in maths are a problem. As one participant of the workshop pointed out, most people would be embarrassed to admit to not being able to read, yet there is absolutely no stigma attached to not being able to do basic maths. Parents, and the general public as a whole, need to come to regard maths, just like reading, as a basic life skill and an essential component of education. Again the problem is ignorance about the importance of maths in everyday life, as well as the career prospects for mathematically skilled graduates.

The media

The media, of course, has a lot of leverage when it comes to public perception. Mathematicians are rarely represented in main stream media, and when they are they don't exactly appear glamorous. And unlike medicine, astronomy and engineering, the latest breakthroughs are unlikely to be reported in the press.

Can the representation of mathematicians and mathematics be improved? The mainstream media can't be expected to do this out of the goodness of their hearts, they need to see some sort of appeal to their readers and viewers. But is there a way of making maths "cool" that doesn't make you cringe? Or should we in the mathematics community just step back in dignity and wait until the media eventually picks up on the subject?

The media, including individual journalists and programme makers, need to be made aware of the impact of mathematics on our daily lives, as well as raising the profile of the more esoteric research. Mathematics must be presented as a human activity, carried out by creative hard-working real people, rather than some sort of magic pursued by the elite few.

What can we do?

And it is here that all those involved in the mathematics community must bite the bullet. There is a part to be played by government, the media, the education sector and the general public. But mathematicians and the people who support and promote the subject are the vital key to changing perceptions and encouraging more students to study maths. We must not hide shyly waiting for the rest of the world to discover our worth. We must champion the subject and explain, in an accessible and engaging way, its importance and appeal.

To turn people back on to maths, we have to provide a convincing argument. Researchers must be prepared to engage with the public and promote their own research and the subject in general. While many researchers are willing to communicate their work to a non-technical audience, not everyone is able to do this unassisted.

Pluschat

Here, outreach projects and the science communication field are vital. At *Plus* we aim to communicate the best, newest, most interesting mathematics in an accessible way to our readers. Other outreach programmes, like the Millennium Mathematics Project, of which *Plus* is a part, are doing the same through providing teaching resources and closing the gap between school and university maths. But are we, and the many other projects, succeeding? What can we do better?

Plus believes that everyone can learn and, more importantly, enjoy mathematics. It's just a matter of finding the content that will inspire and fire your imagination and enthusiasm. Some students will be encouraged to study maths because of its applications or the wages they might earn as a result, and some will be inspired by the intellectual pursuit. Whatever turns people on to maths, there is room for all of us in this mathematical universe. It is down to parents, educational professionals, government, academics and outreach projects like *Plus* to lead students to that universe.

We would like *you* to tell us what you think about these points. Will the suggested solutions work? Can they be implemented at all? Do you have other ideas of your own? Do you think the core of the problem has been identified correctly? Whether you are a teacher, a student at school or university, an academic, a professional mathematician, or an interested *Plus* reader, write to us with your experiences and ideas at plus@maths.cam.ac.uk. The most interesting responses will be published in the next issue of *Plus*.

If you have anything to say about these or any other topics that might be of interest to *Plus* readers, e-mail plus@maths.cam.ac.uk. Let us know if you are happy for your email and our response to be published in *Plus*. (We may edit emails before publication.)



Plus is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.