

Editorial

Do you remember your own mathematical education with fondness and enthusiasm? Did it inspire you to be the mathematician you are today? Do you value the diversity of mathematical colleagues (and perhaps fellow IMA members) you encounter, who graduated from a range of different universities and with different perspectives on mathematics?

I certainly look back on my own degree years as the foundation for my subsequent career. I was well-equipped to become a research mathematician and lecturer in higher education, although perhaps less obviously so for the challenges of management that I have encountered in my more recent career stages. Nonetheless, the ways of thinking I acquired early through my degree education have helped me succeed in my later career. I would hope that courses available to young people starting out today enable them to develop into the problem-solvers, logical thinkers and expert mathematicians we are going to need in the future. I believe this means having a diversity of high quality choices available that take young people from where they are and enables them to fulfil their potential.

As the UK's accrediting body for mathematics degrees, the IMA has particular insight into the quality and diversity of mathematics higher education in the country, and we gain even greater perspective from our Student Members who are starting their mathematical careers. Our accreditation enables graduates to meet the educational requirements for the Chartered Mathematician (CMath) status. From Associate upwards, membership of the IMA requires degree level mathematical education, which many members will have satisfied through completion of a mathematics joint honours or full degree, so as a reader of *Mathematics Today* it is likely that you have personal experience of studying mathematics at degree level. You may well be an employer of mathematical science graduates, and are likely to have some contact with qualified teachers of mathematics, many of whom have degree level mathematical education themselves.

Thus, I argue that as an organisation, and as individual members, we have a strong interest in the quality and suitability of mathematics degrees in preparing the mathematicians of the future.

So, what does the overall landscape look like in mathematics higher education? Is the UK producing the quantity and quality of mathematical scientists needed for the future? Do all young people with an interest in mathematics have good post-18 options?

You may be aware that a number of mathematics degrees have closed recently. An impartial observer might conclude that (a) recruitment to mathematical sciences degrees is dropping (as seems to be the case with some other subjects, for example modern languages) and (b) that the poorer quality degrees are the ones falling by the wayside, indicating that market forces are at work.

Let's look at each of these in turn. Firstly, is recruitment to mathematics degrees falling? In overall numbers, no: there has been a 6% growth in student enrolments to undergraduate mathematics since 2012/13 (to about 15k according to the recent Wakeling report [1]). However, the proportion of total first-year first-degree enrolments in mathematics fell from 34 in every 1000 FTE first-degree students in 2012/13 to 29 in every 1000



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Celebrating success – how do we ensure the diversity of maths grads?

by 2021/22. In particular, the number taking A-level Maths (who thus have the basis for studying mathematics as a degree) has increased significantly without a corresponding uptake at undergraduate level. This seems concerning for mathematics. However, there is more nuance here. At a number of UK universities the number of mathematics undergraduates has in fact grown enormously in recent years. There are several universities that have at least doubled their intake over the last 10 years, and now have first year cohorts of well over 400. At the same time, others have dwindled to below 50.

So, we come to conclusion (b): this must mean that some degrees are just poorer quality. As a regular External Assessor for degree accreditation, I strongly refute this, and data on degree outcomes backs me up. It has been my privilege to visit many UK universities to accredit their mathematics degrees. This has included some of the 'super-departments' with 400 or

more students per intake and some departments whose intake is less than 20 per year.

In my view, excellence is found everywhere in terms of curriculum structure and content, enthusiasm of the staff, and support for skills development in students. The differences are often in the perceived status of the university, which translates into the entry requirements that a department can set. This in turn means that those departments taking in students with lower A-level grades put a lot of effort into supporting students to achieve their potential. In my experience this is not at the expense of producing less capable graduates. This view is backed up by data on student outcomes [2], which showed no difference in overall employment outcomes across the full range of mathematical sciences degrees.

My conclusion is that what is going on here has a lot less to do with the actual quality of mathematics degrees, and much more to do with the general narrative of status and value of certain universities over others. Assuming the trend continues, it is likely to lead to mathematics being concentrated in fewer 'high status' universities, leaving many departments with excellent staff and mathematics programmes struggling to recruit and ultimately becoming financially unviable. While this is depressing for those of us working in universities, a reasonable question to ask is: Does this matter from the student's or potential employer's perspective?

A key issue is that the decreasing number of mathematical sciences degrees on offer, all with similar A-level grade intakes (usually A or A* at A-level Maths and often an expectation of Further Maths A-level), risks reducing the diversity of options available to young people both geographically and in terms of the content of programmes. While the large departments can offer a great range of module options, particularly at final year level, they do tend to have a level of similarity in terms of focus, with the aim of preparing graduates for a future in academic research being much more in mind than it may be at a lower A-level tariff department. Not every young person starting a mathematics degree is aiming for a career in research.

A student who does not achieve an A grade at A-level Maths but who nevertheless enjoys the subject and could go on to have a rewarding mathematically-based career has very few options available to them now, even if they are geographically mobile. Given that those from poor socio-economic and some minority backgrounds are less likely to achieve the highest A-level grades [3], this is likely to disproportionately affect such young people, meaning the overall cohort of mathematics graduates is becoming more homogeneous.

From an employer perspective, if all mathematics graduates arrive with a similar mathematical and personal background, the advantages diversity brings to productivity and innovation are less available via employing mathematicians. Furthermore, reduced diversity may make it more difficult for some employers to find a mathematician who meets their requirements because different employers have different needs.

So what does the future look like? If we carry on as we are, we will still continue to have elite mathematicians in the UK, although possibly with less diversity. I expect large financial employers will continue to find the calibre of candidates they seek. Smaller employers, and those in UK regions without significant mathematics provision, perhaps less so. Moreover, the future for maths teacher recruitment does not look good, with graduates from high tariff universities less likely to choose teaching as a career [2].

If this isn't the future we desire, we need to take action as a community – both those in education and in business. Educators need to think about how to increase the variety of high quality mathematics programmes. More and more students are taking

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A-level Maths – how can we attract them to degrees that enthuse them and produce a wider range of graduates? Engineering has grappled with this problem and pioneering developments such as UCL's Centre for Engineering Education are transforming engineering curriculum and pedagogy in order to inspire future engineers (I admire their rallying cry: 'How to Change the World'). Can mathematics do the same? The Campaign for Mathematical Sciences call for proposals for Maths degrees for the Future Grants is a step towards that (see tinyurl.com/CaMS-maths-grants).

Educators from schools and universities must encourage more A-level students to consider a range of maths courses at university. But solving the challenge also needs employers on board. What types of mathematical sciences graduates, and what kinds of skills, are needed in the workplace? How do we join the dots for young people so that they are less influenced by perceived status and more by the exciting options that await them as a graduate of this wonderful discipline?

The IMA will continue to work to support excellence in higher education through its many initiatives such as the New Lecturers Induction course, the John Blake University Teaching Medal and the Higher Education Teaching and Learning Workshop Series. We also need to make sure we bring the whole community together to address the challenge of delivering inspiring and varied mathematical sciences degrees that enthuse our young people and ensure the supply of graduates that employers require in order to tackle the challenges of the future.

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