1. INTRODUCTION

The Vorderman Report (2011) has reinvigorated debate about the state of mathematics education in England. The statistics it cites are stark: nearly 50% of students fail to achieve GCSE Mathematics in secondary education and England ranks amongst the lowest in the world for rates of students studying mathematics in upper secondary education.

This report explores different approaches to mathematics education in secondary and upper secondary education in the context of the Vorderman Report recommendations. The paper draws together recent research and policy work in the field to draw out key themes including why mathematics is important both for individual attainment and broader educational and economic goals and the main challenges that hinder England’s students from more successful performance and progression. The paper then provides examples of successful or pilot mathematics reforms being trialled in other countries to shed light on and learn from practice overseas that is relevant to the Vorderman recommendations.

The report does not recommend directly importing practice from either of the case study sites, high-achieving Hong Kong or neighbouring Scotland, but rather that their experiences of wide-ranging reforms should inform debate in England.

2. BACKGROUND

Whilst the attainment of English students is at best stable, or even in decline, mathematical skills are growing in importance. Basic numeracy and quantitative skills are increasingly necessary in all jobs and life-skills, for tasks including budgeting and data-handling. And the changing nature of the international economy means that maths skills and knowledge are in higher demand than ever. Science, Technology, Engineering and Mathematics (STEM) industries are becoming increasingly central to economic competitiveness and growth and will provide many of the jobs of tomorrow for young people (Royal Society, 2011).

The reasons for England’s relative underperformance in both attainment and progression are numerous. A growing culture of league-tables and ‘teaching to the test’ (or, performativity) in schools means that decisions about how mathematics is taught and assessed in schools are not always in the best interests of students and have actually resulted in counter-productive practices such as multiple and early entry to GCSE. With insufficient emphasis on functional and basic skills, and post-16 pathways that are usually limited to academic GCE Mathematics or GCSE re-takes, the current range of qualifications has further neglected learner needs and turned many students away from the subject.

There is a range of curriculum and qualification reforms already being explored and in some cases piloted in England. These include the Vorderman Report endorsed ‘linked pair’ GCSE qualification which makes clearer differentiation between functional and academic skills; the recommendation to make some form of mathematics compulsory until 18; and the widening of upper secondary mathematics pathways to include a Mature GCSE and a Maths for Citizenship qualification.

3. INTERNATIONAL CASE STUDIES

Our international case studies similarly emphasise a distinction between academic and functional mathematics: junior secondary education in Hong Kong incorporates both functional and academic content for all students. The favoured approach in Scotland is splitting mathematics into two separate qualifications (Mathematics and Lifeskills Mathematics), with one focusing on academic mathematics and the other on functional and workplace skills.

The case studies also emphasise the importance of being as flexible as possible to meet learner needs, in sharp contrast to the regimented and examination-driven approach that characterises England’s mathematics qualifications. For instance, some Scottish qualifications have no external examinations and the country's bi-level approach means students can move between qualifications easily depending on the...
extent of their progress.

In both Hong Kong and Scotland, upper secondary mathematics qualifications prioritise diversity in curriculum content over diversity in qualification type. In fact, in both countries all students take the same qualifications (in Scotland the Higher and in Hong Kong the NSS). The Higher allows students to study the application of mathematics to real-life and the Hong Kong Diploma allows high-attaining students to specialise in calculus or algebra through the Extended Part. The key point being that in both cases – Hong Kong and Scotland – qualifications are available at different levels and incorporate relevance to the real-world in all qualifications, leaving mathematics in these countries more flexible and less niche.

4. **RECOMMENDATIONS**

More detail on the case studies and how they compare to mathematics education in England is available in the main body of the report but the approaches they outline which might inform or give strength to our own reforms and the recommendations of the Vorderman Report are as follows:

- Qualifications need to be flexible and bi-level to allow students to progress at their own speed and aim for the highest possible grade (as per National 4 and 5 in Scotland). On this basis the linked pair of mathematics GCSEs currently being piloted should be rolled out across England.
- Upper secondary education should offer more than re-takes for students who have not gained GCSE Mathematics
- Further consideration of making mathematics compulsory for all students in upper secondary education is needed and should draw on Hong Kong’s NSS experience
- Mathematics qualifications in secondary and upper secondary education should incorporate functional and academic content (including arithmetic)
- Assessment arrangements should limit performativity, for instance through some element of teacher-led assessment for students studying foundation-level qualifications
- Too much diversity in qualification type can be confusing for students, education-providers and employers. Diversity in curriculum content can be a better route for meeting diverse learner needs (as with the Scottish Higher and Hong Kong’s NSS)
- Once the pilot and evaluation of the linked pair GCSEs is complete, the mathematics community should come together over a one or two day period to consider the big picture and learning from overseas, and develop definitive recommendations for the future of mathematics education in England.

The ideas and examples from home and overseas outlined in this paper should provide some food for thought, in some instances strengthening the case for intended reforms and in others providing new and sometimes challenging thinking. Both will be necessary to realise the goal of creating a ‘world class mathematics education for all’.

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The full report can be found at:

Alternatively, search on the terms ‘Maths problem’ within the RSA website.

The 2011 Vorderman Report can be found at