UK Mathematics 14-19: the Gender Jigsaw

Summary Report for the Joint Mathematical Council of the United Kingdom

Jennie Golding, UCL Institute of Education

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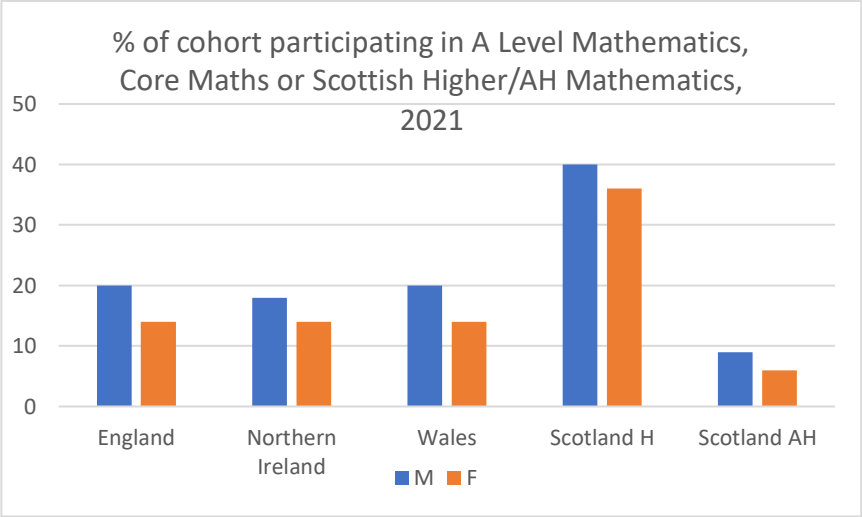
There is persistent evidence that the UK has an inadequate 'pipeline' to the mathematics needed for personal and societal thriving. Further, participation in that pipeline post-16 is significantly skewed towards males. The JMC has therefore commissioned a short report that draws together the evidence related to participation and attainment in mathematics age 14-19, including by gender, across the UK.

Why does it matter? Relative, as well as absolute, participation and attainment matter because mathematics provides access to careers in the range of STEM and social science fields, and associated personal, economic and social benefits. ACME's Mathematical Futures programme takes as a premise that the range and scope of mathematics needed to fully participate in such areas, are likely to continue to expand rapidly.

The full report, available on the JMC website, outlines the policy background to the issue. It summarises recent relevant data by gender across the four home nations, and analyses patterns within those data, relating them to the wider evidence base. It locates that data within wider published global, and UK, evidence. Finally, it draws together some approaches thought to be productive in addressing related some of the issues.

The main findings are:

1. Mathematics education provision in each UK jurisdiction continues in a state of flux. Impacts on participation and attainment have not yet stabilised, and the pandemic from 2020 has led to particular disruption to learning and assessment. Structures in England, Wales and Northern Ireland have much in common, but curricula and assessments have diverged since 2016. Scotland's provision supports greater local autonomy of enactment, and often a wider curriculum to at least age 17.



2. Across the UK, girls enter Mathematics GCSE/N5 and additional mathematics qualifications in comparable numbers with boys at age 16, and they perform at least as well as boys in those qualifications. Approaches to assessment during the pandemic have resulted in the award of significantly enhanced grades, especially to girls. Each year, around 180,000 older students retake GCSE, especially in England, but the 'standard pass' rate remains low and the mathematical benefit is often of questionable mathematical benefit to either boys or girls.

3. Significant differential participation in favour of boys is evident in all significant advanced school mathematics qualifications in the UK except Core Maths, though it is less marked in Northern Ireland. Total advance mathematics entries remaining fairly steady. It is not clear how plummeting AS entries in England have impacted the choices made by students.

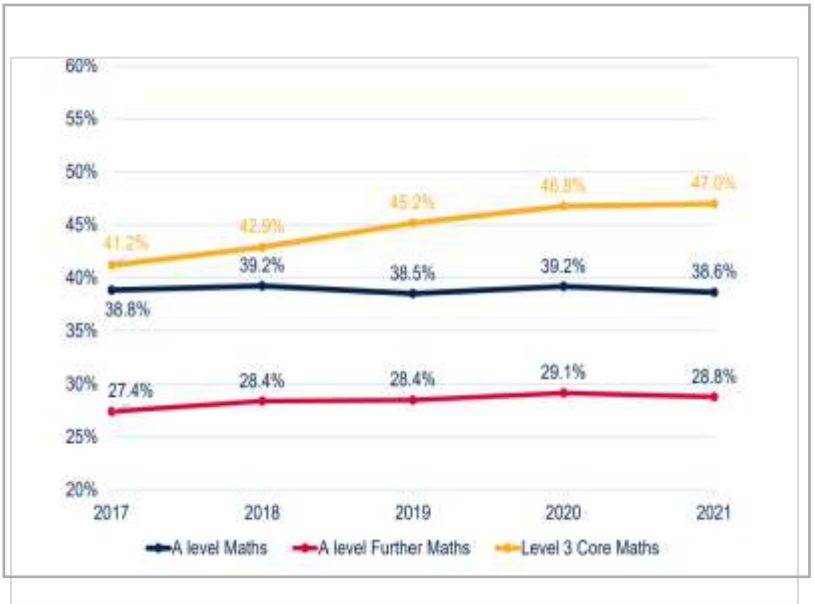
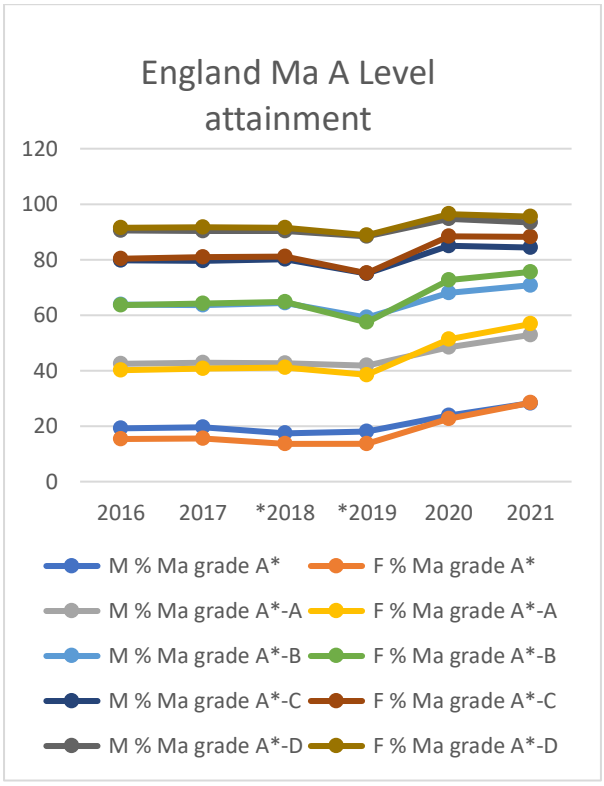
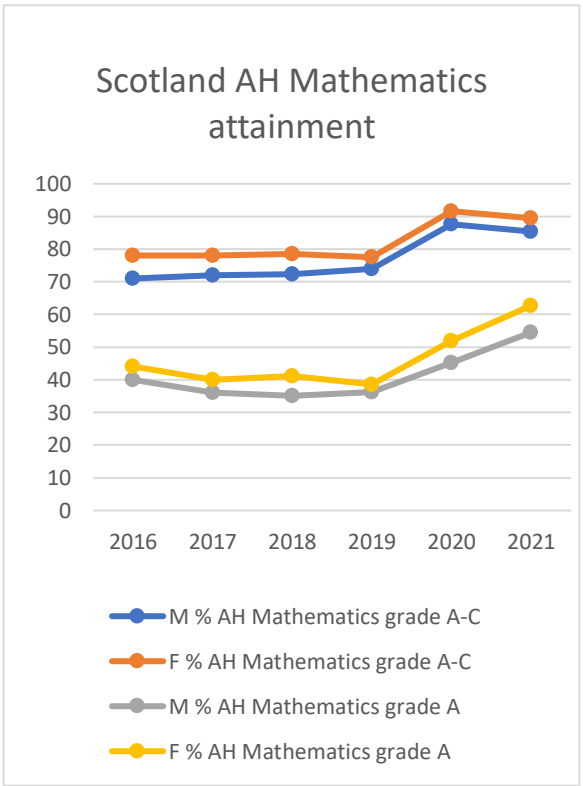


Figure 1: % of female entries for advanced school mathematics qualifications, England, Northern Ireland and Wales, over time

4. Key issues are therefore around provision for previously low-attaining students, gender bias within most advanced school mathematics pathways, and under-participation by previously moderate- or high-attaining students.

5. As with GCSE and N5 mathematics qualifications, the approaches used for assessment during the pandemic resulted in improved grades across advanced school mathematics qualifications, and especially so for girls. However, even before then, there is no systematic evidence of boys routinely outperforming girls at this level, except at the highest grades for Mathematics A Level in England. Indeed, in Scotland, girls routinely outperform boys in both Higher and Advanced Higher Mathematics. Neither is there clear evidence that any of the recent changes to mathematics curriculum and assessment have impacted (positively or negatively) on (girls' or boys') participation or attainment in advanced school mathematics.





6. All four UK nations have participated in recent PISA assessments of mathematical literacy. England and Wales show an improving trend across successive PISA cycles, while Scotland has stagnated and Northern Ireland has remained broadly stable. Boys have often, but not always, somewhat outperformed girls, but not to the extent they do across the OECD as a whole. Accompanying surveys of mathematics-related beliefs and experiences show marked differences by gender, in ways known to be detrimental to girls' future participation, and these differential reports are remarkably persistent across time and UK country. Only England has participated in recent, mathematics curriculum-close, year 9 TIMSS assessments. There has been no significant difference in performance by gender in recent cycles, including, overall, in the recent 'PSI' (problem solving and inquiry) items though again, students' reported affect and experiences are differentially detrimental to girls' continuing participation.

7. International studies show gendered gaps in upper secondary mathematics participation are not inevitable, but they are widespread, and often related to comparatively poor mathematics-related affect or unhelpful stereotypes. Girls are more likely to value, and be influenced by, pedagogic approaches and supportive interactions that are with a range of others. Participation at this level is enhanced by ambitious, connection-making teaching which embraces appropriate challenge and supports students through that. There are also significant gendered issues at the tertiary level and in the workforce, including academia.

8. The evidence shows teaching mathematics for meaning-making and for connections, including to realistic uses of mathematics in across a wide range of contexts, supports the participation of all students, but especially girls. That teaching should also challenge, encourage, support and specifically affirm the mathematical identity and capabilities of all students. It should offer opportunity for working in a range of both collaborative and independent, discursive ways. Developing curricula and pedagogies should also build on gender-specific preferences and interests in harnessing digital tools for mathematical purposes. Other small-scale interventions should target the range of influences on young people's pathways decisions: their peers, their parents and other influential figures, extra-curricular activities, the resources they use and images and roles they encounter, to promote gender-inclusive messaging. Teachers might also consider single-sex activities on occasion.

9. Analysis of data shows post-16 participation in advanced school mathematics in the UK at present remains disappointingly gender-biased, with significant, and likely increasing, implications for individual and for societal thriving. The evidence suggests broad pedagogical, and some smaller-scale, but important, principles that are promising but need to be communicated and enacted; a broader curriculum post-16, and incorporation of mixed, less traditional forms of assessment, also show potential.