

Girls' participation in A level Mathematics and Further Mathematics

A briefing document summarising recent research relating to girls' participation in Advanced level Mathematics and providing recommendations for schools and colleges for increasing girls' participation





Girls' participation in A level Mathematics and Further Mathematics



43% of girls and 65% of boys with an A grade in GCSE Mathematics continue to study Mathematics to at least AS level.

Noyes, A. (2009). *Exploring social patterns of participation in university-entrance level mathematics in England. Research in Mathematics Education, 11(2), 167-183*

The number of students taking A levels in Mathematics and Further Mathematics in the UK has risen considerably over the last ten years.

In 2015, Mathematics was the fourth most popular A level amongst girls, behind English, Psychology and Biology whilst it was the most popular subject taken by boys. The participation rates at AS level were similar with Mathematics being the third most popular for girls, after English and Psychology, but the most popular subject taken by boys. The proportion of students taking Mathematics (AS/A level) who are girls is around 40% with the corresponding figure being 30% for Further Mathematics (AS/A level).

The Further Mathematics Support Programme (FMSP) promotes participation in Advanced level Mathematics to all students who would benefit from taking the qualifications, especially girls. This document summarises the key findings from the recent FMSP/UCL Institute of Education (IOE) Gender Literature Review and provides details of the interim findings from FMSP/IOE gender case studies, which aim to identify and share good practice in promoting participation in Advanced level Mathematics by girls. The full reports can be downloaded from:

www.furthermaths.org.uk/encouraging-girls-maths



We hope that the guidance provided in this document will be a stimulus for reflection by colleagues in schools and colleges on the issue of girls' participation. It is hoped that the recommendations listed at the end of the document will help to initiate practical action to increase the proportion of girls who progress to study A levels in Mathematics and Further Mathematics.

It is an important time for all stakeholders to consider the role they will play in promoting post-16 mathematics, particularly to girls.

Student entries for Mathematics and Further Mathematics in the UK

Course	2005		2015	
	Female	Male	Female	Male
AS Mathematics entries	27,258 (40.0%)	40,920 (60.0%)	64,984 (39.3%)	100,327 (60.7%)
AS Further Mathematics entries	1,697 (33.6%)	3,357 (66.4%)	7,902 (29.2%)	19,132 (70.8%)
A level Mathematics entries	20,178 (38.1%)	32,719 (61.9%)	35,937 (38.8%)	56,774 (61.2%)
A level Further Mathematics entries	1,695 (28.6%)	4,238 (71.4%)	4,177 (29.1%)	10,186 (70.9%)

Percentage of cohort for each qualification given in brackets. Source: JCQ

In 2015, Mathematics was the most popular subject at both AS and A level



In May 2014, it was announced that future school performance tables would include data on the proportion of A level students who take science and mathematics. The data listed includes participation rates for both genders by individual school, institution type and region, in Mathematics, Further Mathematics, Physics, Chemistry and Biological Sciences. The table below summarises the data for A level Mathematics and Further Mathematics for the

year 2014-15 (taken from www.gov.uk/government/statistics/a-level-and-other-level-3-results-2014-to-2015-revised).

Data for the academic year 2013-14 can be found at: www.gov.uk/government/statistics/a-level-and-other-level-3-results-2013-to-2014-revised and for 2012-13 at: www.gov.uk/government/statistics/a-level-and-other-level-3-results-england-2012-to-2013-revised

A level Mathematics and Further Mathematics (FM) participation rates for the year 2014-15

Participation rates are given as a proportion of the number of students aged 16-18 who entered for at least one A level in the academic year. Figures in brackets show the raw increase or decrease from 2013-14 in the proportion of the cohort taking Mathematics and Further Mathematics.

Region	% taking A level Maths	% taking FM A level	% taking A level Maths (boys)	% taking FM A level (boys)	% taking A level Maths (girls)	% taking FM A level (girls)
North West	24.3 (-0.3)	3.6 (+0.4)	34.6 (+0.9)	6.0 (+0.7)	16.6 (-1.0)	1.9 (+0.3)
North East	22.5 (+0.5)	3.8 (+0.3)	33.7 (+2.1)	6.5 (+0.1)	14.6 (-0.4)	1.8 (+0.4)
Yorkshire & the Humber	22.3 (-0.4)	3.4 (+0.3)	33.8 (+0.9)	5.8 (+0.4)	15.4 (+0.4)	1.5 (0)
West Midlands	25.1 (-0.5)	3.2 (-0.1)	35.3 (-0.5)	5.4 (-0.3)	17.2 (-0.5)	1.5 (0)
East Midlands	25.1 (-0.6)	4.1 (+0.1)	36.4 (+1.0)	7.1 (+0.5)	16.6 (-1.6)	1.8 (-0.1)
East of England	26.3 (+0.3)	4.5 (+0.2)	36.9 (+0.2)	7.8 (+0.5)	17.6 (+0.3)	1.9 (+0.1)
Inner London	28.3 (+0.4)	3.9 (+0.1)	41.7 (+2.4)	6.9 (+0.2)	19.2 (-0.6)	1.8 (0)
Outer London	34.0 (+0.5)	4.9 (-0.2)	44.4 (+0.3)	7.9 (-0.1)	25.5 (+0.8)	2.4 (-0.3)
South West	24.8 (-0.4)	4.2 (-0.1)	35.2 (-0.7)	7.3 (0)	16.5 (-0.1)	1.7 (-0.1)
South East	27.7 (+0.1)	4.8 (0)	38.4 (+0.6)	8.2 (+0.5)	19.2 (+0.1)	2.0 (-0.3)
England*	26.5 (+0.1)	4.1 (+0.1)	37.2 (+0.6)	7.0 (+0.3)	18.1 (-0.2)	1.9 (0)

*State funded sector schools and colleges only. For all schools and colleges in 2014-15 the proportions entered for Mathematics and Further Mathematics were 28.6% and 4.9% respectively. In 2013-14 the proportions were 28.4% and 4.8% for all schools.

Key findings drawn from these data are:

- The participation rates for 2014-15 were very similar to those in 2013-14, with the overall proportion taking A level Further Mathematics increasing from 4.0% to 4.1%. Across all regions, boys remain over 3.5 times more likely to take A level Further Mathematics than girls.
- For A level Mathematics overall participation increased slightly, but this masked an increase in participation by boys compared to a slight fall in participation by girls. Across all regions, boys are around twice as likely to take A level Mathematics as girls.
- By region, participation for both genders was highest for Mathematics and Further Mathematics in London and the South East. In contrast the lowest participation rates in A level Mathematics for both genders were in the North East and Yorkshire and Humber; for Further Mathematics the lowest rates for both genders were in the West Midlands and Yorkshire and Humber.

The DfE data summarises girls' and boys' participation in Advanced level Mathematics and sciences by school and region



Science and maths makes you more prepared for life and for business.

*Dr Melanie Windridge
YourLife Campaign*

Research evidence into factors affecting girls' participation in Advanced level Mathematics

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...the unequal participation of women in STEM identifies a potential source for recruiting more mathematicians.

FMSP/IOE Gender Literature Review

As part of their work with the FMSP, the UCL Institute of Education (IOE) produced a literature review of recent national and international findings on gender participation and performance in post-compulsory mathematics.

Prior attainment in mathematics was found to be the most significant factor in progressing to A level, but boys were more likely to continue to A level than girls with the same GCSE grade. This disparity becomes much more pronounced for students with A or B grades, suggesting that girls may see good, but not excellent, grades as a barrier to progress.

Students were more likely to choose mathematics if it was their highest grade at GCSE. With girls attaining more A/A* grades across the full range of GCSE subjects, their positioning as 'all-rounders' may negatively affect their uptake of A level Mathematics.

Enjoyment was more likely to be cited by girls than boys as a reason for STEM related choices.

Girls have been found to have a lower mathematics **self-concept** than boys of the same ability; this is of concern because research shows the degree of match between task performance and self-concept is linked to intention to continue with mathematics.

Students were found to be aware of the **stereotypical images** of mathematicians, but they still used them. Female students were also sometimes distanced by presentation of images of highly successful, attractive female mathematicians, meaning the images had the reverse effect to that intended.

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Girls taking A levels in Business Studies, Economics, Geography, Psychology and Sociology would all benefit from studying mathematics as a supporting subject because of the mathematical content of these courses.

FMSP/IOE Gender Literature Review

A lack of awareness of the **utility of mathematics** affected students of both genders.

Advice and encouragement to continue with mathematics from a teacher or family member was found to be important; and this could mediate the effect of lower mathematics self-concept for girls in particular. Research evidence acknowledges the importance of **socio-economic factors** and the impact of 'science capital'. Students who had formed an opinion against pursuing mathematics and science in the future by age 10 were highly unlikely to change their minds by the age of 14.



Successful strategies for girls' participation in mathematics: Case Studies



The case study schools had not been involved in specific initiatives to attract girls to study mathematics; instead there was a strong culture of encouraging girls to aspire to take mathematics at A level.

FMSP/IOE Case Studies



SLTs should identify ... a gender champion whose role includes bringing together the whole school in a coherent campaign to challenge gender stereotypes.

Opening Doors: A guide to good practice in countering gender stereotyping in schools, IOP, 2015

From October 2014, the UCL Institute of Education has been working with the FMSP to produce five case studies of schools and colleges that are making an impact on improving girls' participation in Advanced level Mathematics.

Through analysis of data, teacher and student focus groups and lesson observations, researchers have examined strategies that have contributed to effective change in the take-up of A level Mathematics and Further Mathematics.

- The support of **senior leaders** is seen as crucial in guiding the development of a clear whole-school culture which promotes participation in post-16 mathematics by girls and supporting an **appropriate curriculum** within the mathematics department. For example, three of the case study schools prepare students for the AQA Level 2 Certificate in Further Mathematics, which offers students an insight into what is involved in A level Mathematics. This is beneficial to girls who report that they feel more confident in progressing to A level having been exposed to more challenging mathematics during Key Stage 4.
- **Careers advice** starts early and illustrates the utility of mathematics across a range of disciplines. At Shenley Brook End Academy, students have researched possible university courses by Year 11 and noted that mathematics was necessary for a range of careers including the armed forces and sports science. At Beauchamp College, mathematics is valued as a currency that keeps options open and is a gateway to specific careers, including optometry, medicine, food nutrition, youth work, forensic science and physics. Wall displays highlight the importance of mathematics.

At the Further Education College, personal careers advice for new and prospective students emphasises pathways in which mathematics is an essential companion or a central subject.

- The role of **mathematics teachers** in supporting girls and getting to know them individually is valued by female students. They like teaching strategies that provide opportunities for checking understanding with friends and quiet conversations with the teacher. Teachers in the three mixed schools described the importance of directing questions to girls in class. In several of the schools, the mathematics department's 'open door' policy was seen as crucial in building girls' confidence.
- In the case study schools, girls' participation is seen to be assisted by strong **family appreciation** of the value of mathematics and the role of hard work. Family support for the study of mathematics was particularly high in non-white British ethnic groups. Students in the Further Education College were dismissive of negative cultural messages amongst some young people, such as it being 'smart to dumb down'.
- The messages about participation in Further Mathematics focused on **motivation** rather than simply focusing on the cleverest group of students in the year group.
- All of the case study schools/colleges offer A level Mathematics options that include **statistics** in Year 12. This was promoted as beneficial because of the social science applications, which may be particularly attractive to girls.



Recommended strategies for promoting greater gender balance in Advanced level Mathematics



Strategies that senior leaders and heads of mathematics departments could implement to promote greater gender balance in the uptake of A level Mathematics and Further Mathematics:

- ✓ Consider the gender balance in previous A level cohorts. Use the DfE tables to identify the relative participation rate of girls in relation to similar local schools and against the national picture. Look for **trends in progression** from Year 11 classes and/or feeder schools.
- ✓ **Identify and support girls in Year 10/11** who show the potential and/or interest in mathematics to progress to post-16 study. Analyse the proportion of girls and boys with an A or A* in GCSE Mathematics who progress to study mathematics to at least AS level.
- ✓ Introduce more **mathematics topics and qualifications alongside GCSE** for students expected to get a grade B or above. Girls value the opportunity to evaluate their interest in the topics they might meet at A level and how they might cope with the more demanding material.
- ✓ Throughout Key Stages 3 and 4, develop a **school-wide culture** in which girls aspire to study mathematics to A level.
- ✓ Teachers should embed advice about how mathematics is used in **real life contexts** into lessons to make students aware of the utility of the subject.
- ✓ Teachers should provide students, especially female students, with regular positive feedback on their progress and ability. Praise resilience, discussion and careful work, and support female students in developing a **more accurate match between task performance and mathematics self-concept**.
- ✓ Avoid presenting A level Mathematics as a 'specialist' subject – emphasise the **general benefits** of studying the subject.
- ✓ Present a **clear message to staff** interviewing and enrolling students to A level courses about the possible barriers that may need to be broken down when recruiting girls to post-16 mathematics courses and provide **clear information** about the importance of A level Mathematics and Further Mathematics qualifications.
- ✓ **Engage with parents/carers** about the importance of promoting a positive message to both boys and girls about progressing to study mathematics post-16.
- ✓ Provide clear messages to students, and girls in particular, about the **wide range of careers and degree courses** for which post-16 study of mathematics would be beneficial. Invite current or previous female A level Mathematics students to speak to younger students about the importance of mathematics in their degree course or future employment, both in STEM and non-STEM fields.
- ✓ Present images of a **range of male and female users of mathematics**, importantly including those across a range of different levels of ability.

The Further Mathematics Support Programme

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The Further Mathematics Support Programme

The Further Mathematics Support Programme (FMSP) is a government-funded initiative supported by the Department for Education and managed by MEI. The FMSP supports schools and colleges at Key Stage 4 and post-16 level to increase teacher expertise and student participation in AS/A level Mathematics and Further Mathematics.

The FMSP produces dedicated website content encouraging and supporting girls in participating in Mathematics and Further Mathematics A levels and organises events with female speakers from industry and higher education and a range of exciting and engaging activities and workshops to promote mathematics.

Further details

www.furthermaths.org.uk/encouraging-girls-maths

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If you have any comments or queries relating to this publication, please contact Claire Baldwin:

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