Written Evidence Submitted by Protect Pure Maths

(DIV0086)

1. About us

1.1 Pure maths is a part of the continuum of the mathematical sciences. It usually involves the study of abstract concepts like number, logic, geometry and algebra. For centuries, discoveries in pure maths have led to applications and achievements in every area of science and technology. But progress is not always easy to predict and can take many years.

1.2 Despite its value to society, maths does not always receive the funding and support it warrants. Today, some UK universities are cutting back their maths provision.

1.3 Protect Pure Maths was established to engage with the academic community and Government to campaign against further cuts and to ensure that the mathematical sciences are understood, valued, and properly funded, and to advance mathematical sciences in the UK. It has been founded in collaboration with the London Mathematical Society.

1.4 We have focused our response to the call to evidence on those areas where we have a particular perspective.

2. Overview

2.1 There is significant underrepresentation of women, LGBTQ+ communities, ethnic minorities, people with disabilities and those from disadvantaged socioeconomic backgrounds across many STEM disciplines, including the mathematical sciences.

2.2 The low participation rates of individuals with protected characteristics in mathematics particularly at the higher levels of research and teaching, makes our discipline poorer and represents missed opportunities for the advancement of mathematics.

2.3 For example, the significant contributions and lasting legacies to mathematics made by Mary Somerville, Ada Lovelace and Alan Turing, right through to Hannah Fry's YouTube videos that inspire maths students today underline the importance of widening participation and improving access to mathematics at every level of education.

2.4 We believe that enhancing access to mathematics education, promoting diversity and addressing underrepresentation in STEM careers must be a priority not only because mathematics education has a huge impact on individuals' life chances and their future earning potential, but also because of the wider social and economic benefits that a thriving mathematics sector brings.

2.5 Protect Pure Maths is committed to making mathematics at higher education more accessible and promoting greater equality, diversity and inclusion.

3. The nature or extent to which women, ethnic minorities, people with disabilities and those from disadvantaged socioeconomic backgrounds are underrepresented in STEM in academia and industry

3.1 There are significant challenges for the mathematical sciences in relation to diversity, across a wide range of protected characteristics including socioeconomic background, gender, ethnicity and people with disabilities.

3.2 However, it should be noted that the availability of data surrounding diversity in mathematics is limited which is problematic in assessing the current situation as well as future progress.

Socioeconomic background

3.3 Just 25% of disadvantaged pupils achieve a good pass in GCSE maths. The attainment gap between the lowest and highest achievers is also wider than the Organisation for Economic Co-operation and Development (OECD) average. Those who do not achieve a good pass, or have a negative experience of maths at school, are much less likely to go on to study maths at A Level or in Further Education and are therefore inadvertently locked out of the system and denied the multiple opportunities that education and qualifications in STEM can offer in the long-term.

3.4 In 2019, 7% of all students taking A-level Further Mathematics were classified as disadvantaged[1], compared with 12% of all A-level students[2] and c.30% of the state school population as a whole. The majority of those going on to study a degree in mathematical sciences have taken A-level Further Maths[3], so this is a key indicator of how many disadvantaged students will go on to study mathematical sciences at university.

3.5 The Education Endowment Foundation recently found that at primary school level pupils from socio-economically deprived backgrounds have fallen further behind in maths since the onset of the pandemic. This is concerning for the future maths pipeline.[4]

Ethnicity

3.6 There is a difference in the proportion of white and Black, Asian and minority ethnic students awarded a first or 2.1 degree in mathematical sciences. For example, the percentage of white students receiving a first or 2.1 in a mathematical sciences degree is 12.5 percentage points more than Black students.[5]

3.7 In relation to the workforce, the APPG on Diversity in STEM found that "STEM has a lower share of Black workers (2% in engineering, technology, science and maths compared to 3% in the rest of the workforce) across all sectors apart from health, and a lower share of Bangladeshi and Pakistani workers in science, maths and engineering (1% compared to 2% in the rest of the workforce).[6]" Data is unavailable for mathematical sciences specifically.

People with disabilities

3.8 Mathematics and science underperform on representation of people with disabilities: 10% of workers in this field have disabilities compared to 14% in the rest of the workforce[7].

Gender

3.9 There remains a significant gender gap in the mathematical sciences.

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[1] Education Statistics Service, https://explore-education-statistics.service.gov.uk/data-tables/permalink/37257ab0-4c21-4aec-b7ae-6f908b113e69

[2] Ibid

[3] Institute of Mathematics and its Applications (IMA), https://ima.org.uk/4900/transition-stem-degrees-maths-level/

[4] Education Endowment Foundation, 7 May 2021

[5] Advance HE (2021) Ethnicity awarding gaps in UK higher education in 2019/20.

[6] 'The State of the Sector: Diversity and representation in STEM industries in the UK', APPG on Diversity in STEM, (November 2020) Analysis of the ONS Labour Force Survey

[7] 'The State of the Sector: Diversity and representation in STEM industries in the UK', APPG on Diversity in STEM, (November 2020) Analysis of the ONS Labour Force Survey

3.10 In 2020/21, there were 34,065 female entrants for A Level, compared to 54,178 male entrants. For the study of further maths A Level, these figures were even starker with just 4,201 female entrants, compared with 10,361 male entrants[8].

3.11 According to the latest higher education student statistics in 2019/20, of the 46,790 students studying the mathematical sciences, just 17,400 (37%) were women[9].

3.12 Among academic staff at UK HEI there is also a lack of gender diversity. In 2019/20 academic year, there were 6,830 (34%) female staff and 13,320 (66%) male staff working in biological, mathematical and physical sciences across UK HEI's[10].

3.13 However, it should be noted that in 2022, the Presidents of four mathematical science societies; the London Mathematical Society (LMS), the Edinburgh Mathematical Society, the Centre for Mathematical Sciences (CMS) and the Royal Statistical Society (RSS) are now all women.

4. The implications of these groups being underrepresented in STEM roles in academia and industry;

4.1 Deloitte has estimated that the mathematical sciences add more than £200bn to the UK economy, nearly 10% of our GDP[11]. The mathematical sciences are of fundamental importance to the UK. Mathematics underpins today's most exciting and urgent technological developments, including artificial intelligence, driverless cars, the development of quantum computers, and superfast broadband. Maths is also a leading source of IP creation, underpins national security and the finance sector and it has been vital to modelling the COVID-19 outbreak and the rollout of vaccinations.

4.2 We need a pipeline of talented mathematicians from diverse backgrounds to continue to deliver in the century ahead. Our supporters from the business community are clear that the skills and expertise of mathematicians must be nurtured and grown and we are working with partners to assess current labour market shortages of mathematicians.

Miquido

"Maths is strictly embedded into computer technology, and IT businesses would not exist without it. It's Math to provide us with tools to understand science, engineering, and technology. These areas are developing rapidly, and we will need more and more experts in those fields.".

Skin Analytics

"At Skin Analytics maths underpins everything we do. …We must continue to invest in all forms of maths to build a bright future of tomorrow."

Deep Render

"At Deep Render, we are developing the next generation of compression technology to free the world of all bandwidth limitations. … most of our breakthroughs came from interactions

[8] Create your own tables, Table Tool – Explore education statistics – GOV.UK (explore-education-statistics.service.gov.uk)
[9] HESA open data and official statistics
[10] Definitions: Staff | HESA
[11] Deloitte, 2012: 'Measuring the economics benefits of mathematical science research in the UK'

with Pure Mathematicians we inspired to help us in our mission; and most of Deep Render's lead researchers have a Mathematics background."

4.3 Additionally, the fact that mathematical sciences form the basis of technologies driving societal change means that we need to avoid systematic biases that may result from a lack of diversity. A well-known example of such biases is that of facial recognition technology.[12]

4.4 Importantly, the mathematical sciences can be a path for social mobility. Mathematics education at all levels presents huge opportunities for individuals' career advancement. Numeracy is fundamental to an individual's life chances; mathematics is one of the top three subjects for graduate earnings; and research into the mathematical sciences is estimated to directly create employment for 2.8 million people in the UK[13]

5. What could and should be done by the UK Government, UK Research and Innovation, other funding bodies, industry and academia to address the issues identified.

5.1 Protect Pure Maths believes that more could and should be done by the UK Government and other bodies to address underrepresentation in mathematics.

5.2 Protect Pure Maths was initially established in response to some UK universities cutting back their maths provision. Whilst Government may not want to intervene in institutional decisions, Government should make clear the strategic importance of maths and to incentivise and support universities to prioritise maths.

5.3 One of our primary concerns is a decade-long trajectory suggesting that departments most at risk in recruitment of mathematical scientists are at smaller HE institutions with lower tariff entry requirements. This has been accelerated by the removal of the funding cap and the changes in assessed A-level grades during the pandemic. The clustering we observe may works counter to the government's levelling up agenda and may incentivise universities to raise their entry requirements. Given the socio-economic disparity at GCSE and A Level in performance, this is a source of concern. It is important to ensure geographical provision of mathematics at HE, given the barriers of entry presented by the cost of accommodation and travel for prospective mathematics students. Equally, it is therefore critical that geographical diversity and access to mathematics courses is maintained so that they can be accessed by more diverse groups of people. This means supporting mathematics departments in under-represented institutions and geographical locations and supporting them to widen access and participation.

5.4 More broadly, the Government must ensure that maths funding properly reflects the value of maths to society. This means delivering and report on the £300m funding for mathematical sciences research announced in January 2020.

5.5 We support broader measures to improve the pipeline at primary age by providing the help that pupils need in schools rather than relying on parental support. More should be done to ensure that there is a good supply of STEM / mathematics teachers, including incentives for encouraging teachers to remain in the profession as well as join.

5.6 Government and Parliament should do more to recognise and celebrate the contribution of mathematical sciences to the UK economy, thus raising the status of, and building understanding of careers in mathematical sciences. Policy makers should seek to include the

[12]The Alan Turing Institute, 2020, 'Understanding bias in facial recognition technology'
[13] Ibid

perspectives of mathematicians in policy making, including through the Parliamentary Office for Science and Technology (POST). We also support the renaming of the Science and Technology Committee as the Science, Technology and Maths Committee to reflect the importance of mathematics.

5.7 Better information and data management is required. We recommend improved recording of, and improved consistency in EDI data for subjects across the higher education sector. At present national and subject specific data is limited, which makes monitoring of trends and progress difficult. We also recommend better reporting of subject specific data by the Office of National Statistics (ONS) and creation of a UK maths 'dashboard' to track progress.

5.8 This should be linked to a national strategy for improving diversity in STEM led by the UK Government.

(January 2022)