Written evidence submitted by the Association of the British Pharmaceutical Industry (ABPI) (GAP0070)

1. About the ABPI

1.1. The Association of the British Pharmaceutical Industry (ABPI) represents innovative research-based biopharmaceutical companies, large, medium and small, leading an exciting new era of biosciences in the UK. We represent companies who are researching and developing the majority of the current medicines pipeline, ensuring the UK remains at the forefront of helping patients prevent and overcome disease.

1.2. Key industry facts:

- The UK pharmaceutical sector invested £4bn in research and development in 2015, more than any other sector¹;
- There are 62,000 high skill, high value jobs in the pharmaceutical industry in the UK and with strong clusters in the South East, North West and Scotland, the sector brings economic benefits across the country.²
- Pharmaceutical manufacturing employees have the highest Gross Value Added (GVA) of any high-technology sector – over £330,000 per employee;³
- In 2014, pharmaceutical companies invested 16 per cent of their European R&D budget in the UK. This compared with 9.4 per cent of European sales in the UK⁴.
- 25 per cent of the world’s top prescription medicines were discovered and developed in the UK⁵;
- Pharmaceutical companies develop medicines for diseases such as dementia to improve healthcare for UK patients. The industry is committed to tackling the global challenges of antimicrobial resistance (AMR), HIV/AIDS, and malaria.
- The UK pharmaceutical sector generates exports worth £30bn and a trade surplus worth around £3bn⁶.
- ABPI members supply 90 per cent of all medicines used by the NHS.

¹ Office for Life Sciences, “Life Sciences Competitiveness Indicators” (May 2016), p. 25
² Office for National Statistics, “JOB03: Employee jobs by industry” (December 2016), https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employeejobsbyindustryjobs03
³ Calculation performed by The Office of Health Economics. Data supplied from Office of National Statistics (ONS), Note: GVA per worker at industry level has been calculated by dividing industries’ GVA at current prices (2013) by the number of workers. Number of jobs at industry level are available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employeejobsbyindustryjobs03 [accessed on August 31, 2016]
⁴ European Federation of Pharmaceutical Industries and Associations, “The Pharmaceutical Industry in Figures: Key Data 2016”, pp. 7, 15. The size of the UK pharmaceutical market is based on sales at ex-factory prices in 2014
2. Executive Summary

2.1. The ABPI represents innovative biopharmaceutical companies, large, medium and small, who are researching and developing the majority of the current medicines pipeline, ensuring the UK remains at the forefront of helping patients prevent and overcome disease.

2.2. The ABPI collects data on the skills gap in the pharmaceutical sector regularly by surveying industry. Our most recent report, *Bridging the skills gap in the biopharmaceutical industry: Maintaining the UK's leading position in life sciences, November 2015*, can be found on our website [here](http://www.abpi.org.uk/our-work/library/industry/Documents/Skills_Gap_Industry.pdf) and provides much of the evidence for our response. Notably, the report highlighted major skills gaps in mathematical and computational areas, which have emerged due to the rapid development of new disciplines such as systems biology and health informatics. Other skills shortages were more long-standing, such as in translational medicine/clinical pharmacology, which requires complex understanding to bridge the gap between bench and bedside.

2.3. The 18 per cent increase in the number of STEM graduates in the UK between 2004 and 2014 is welcome. However, some of this increase is due to an increased number of non-UK domiciled graduates. The number of UK domiciled STEM graduates increased by 14 per cent. In the same period, the number of non-UK EU domiciled STEM graduates increased by 72 per cent and the number of non-EU domiciled STEM graduates increased by 51 per cent. In the context of the UK leaving the European Union, it is important the Committee consider the impact that a new immigration policy will have on the number of STEM graduates in the UK.

2.4. As set out in the terms of reference, this submission focuses on what STEM skills were found to be needed in the past; how the skills need was addressed, the cost of it, how it was funded; and the results. We focus on four specific skills areas which are of high importance to the biopharmaceutical sector:

1. Data analysis (informatics, data mining and statistics)
2. Animal research (pharmacology and physiology) skills
3. Clinical pharmacology
4. Core mathematical skills.

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3. Recommendations

3.1. The ABPI recommends that businesses, Government, schools, colleges, universities, charities, organisations and individuals collaborate to execute the following actions:

Global competitiveness

3.2. Government should develop an immigration system which facilitates ease of movement for talented/skilled students, researchers and workers.

3.3. The recommendation of the November 2016 Advanced Therapies Manufacturing Taskforce (ATMT) report to develop an end-to-end talent management plan to secure the relevant skills for emerging manufacturing technologies should be implemented.

Data analysis (informatics, data mining and statistics) skills

3.4. The upcoming government industrial strategy and life sciences strategy should include specific, targeted measures to address the identified STEM skills gaps in the life sciences sector, in particular focusing on data analysis (informatics, data mining and statistics).

3.5. The skills of the UK data workforce should be developed through:
   - Targeted training and continuing professional development, including the creation of high level apprenticeship training routes,
   - Raising awareness of the wide-range of opportunities in the biopharmaceutical industry, and
   - Creating better links between employers and higher education institutions.

Animal research (pharmacology and physiology) skills

3.6. Mechanisms and funding should be found to sustain activities like those which have been shown to successfully address the skills gap, such as programmes provided by the Integrative Mammalian Biology (IMB) centres and joint British Pharmacological Society (BPS) and Physiological Society short courses.

3.7. Further efforts should be made to ensure in vivo exposure is included at undergraduate and MSc level, providing a select cohort of undergraduate students with the knowledge, expertise, and skills to be able to undertake integrative physiology and pharmacology investigations, as suggested by Lewis (2012).9

Clinical pharmacology skills

3.8. Recommendations in the British Pharmacological Society evaluation of Integrative Pharmacology Fund (IPF) should be implemented, including continued support for undergraduate programmes and early career researchers, and fostering collaborations across academia, industry and the NHS.

3.9. The 2016 extension of the MRC Clinical Pharmacology and Pathology Fellowship Programmes demonstrates that initiatives like this are valued by industry and academia. Successful programmes like these should be supported with long-term funding.

3.10. Ways in which the pool of clinical pharmacology physicians could be expanded should be explored, for example through offering sub-specialist training in this discipline to specialists in

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other areas. Provide ways to support opportunities to work in a biopharmaceutical company as part of training.

3.11. Whilst the training of medically qualified clinical pharmacologists should remain a priority, action should be considered on raising the awareness and attractiveness of clinical pharmacology career paths to a wider range of graduates from quantitative disciplines.

Core mathematical skills
3.12. The complete pipeline for the development of appropriate mathematical skills must be considered, including:
   - Extending opportunities for students to study maths alongside science subjects post-16,
   - Universities increasing emphasis on level 3 maths entry requirements for bioscience courses,
   - Universities including quantitative aspects and modules requiring practical use of mathematics at all levels in bioscience courses to better prepare students for further study and work in scientific disciplines,
   - Raising awareness and uptake by UK graduates of Masters and PhD level training in statistics, data mining, mathematical modelling and related disciplines.
4. Global competitiveness

4.1. The UK’s position as a leader in Life Sciences is underpinned by the ability to attract, develop and retain a highly skilled workforce. The 18 per cent increase in the number of STEM graduates in the UK between 2004 and 2014 is therefore welcome. However, some of this increase is due to an increased number of non-UK domiciled graduates. The number of UK domiciled STEM graduates increased by 14 per cent between 2004 and 2014. In the same period, the number of non-UK EU domiciled STEM graduates increased by 72 per cent and the number of non-EU domiciled STEM graduates increased by 51 per cent.\(^8\) In the context of the UK leaving the European Union, it is important the Committee consider the impact that a new immigration policy will have on recruitment, both graduate and experienced, in the UK.

4.2. There remains a need to access talent from abroad including through intra-company transfers. A key feature of the UK’s success in life sciences has been the ability for talented people to move and collaborate freely across universities and industry both within and outside the EU. This remains critical for developing the next generation of innovators and business talent.

4.3. Following the referendum vote on June 23 2016, at the request of Government, the UK life science sector set up the UK EU Life Sciences Steering Committee to produce a report on how to maintain and grow the UK’s world leading Life Sciences sector following the UK’s departure from the EU.\(^10\) One of the four key areas industry identified was ensuring continued access to the best talent.

4.4. Government and industry set up the Advanced Therapies Manufacturing Taskforce in March 2016. It published a report\(^11\) in November 2016, recommending actions to anchor the manufacture of advanced therapy medicinal products (ATMPs) in the UK. The UK has a lead in the research of biopharmaceuticals but none of the top 10 biopharmaceuticals are manufactured in the UK. The Taskforce’s report includes recommendations to ensure that the UK workforce has the relevant skills to appeal to internationally mobile investors.

Recommendations

4.4 Government develops an immigration system which facilitates ease of movement for talented/skilled students, researchers and workers. The system should be needs-based, straightforward, rapid, avoid additional costs to industry and provide certainty of outcome for both applicants and the company wishing to employing them. It should have a reciprocal agreement with Europe whilst also improving the current system for immigration from the rest of the world. The intra-company transfer process should continue to facilitate movement into the UK of people employed overseas by pharmaceutical companies.

4.5 The recommendation of the November 2016 Advanced Therapies Manufacturing Taskforce (ATMT) report to develop an end-to-end talent management plan to secure the relevant skills for emerging manufacturing technologies be implemented.

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5. Data analysis (informatics, data mining and statistics)

What skills were needed?

5.1. Data analysis in pharmaceuticals includes a number of skills vital to the industry including:

- Systems biology, which integrates experimental and computational research to better understand complex biological processes.
- Bioinformatics and computational systems biology, which uses statistical techniques to interpret large sets of biological data.
- Data mining, the process of analysing large sets of data to find correlations or patterns.
- Pharmaceutical statistics, which involves experimental design, sample size calculations, data collection, and the analysis, interpretation and presentation of results.

5.2. Skills in this area are in high demand in a number of different sectors, leading to competition for people with the right skills and relevant experience. ABPI’s 2015 survey found that in the pharmaceutical industry in the UK:

- Bioinformatics/computational systems biology has become a high priority area since 2008.
- Statistics was identified as high priority for action on skills in 2008 and remains so in 2015.
- Data mining is an emerging discipline that was not rated in the 2008 ABPI skills gap report, but was a high priority in 2015.

5.3. The Science Industry Partnership/Cogent Skills report, ‘Skills Strategy 2025’ supports these findings, concluding that informatics and big data skills is one of the five key skills gaps which have particular importance for science employers.12

How were they addressed?

5.4. Some pharmaceutical and healthcare companies have begun hiring data analysts from other industries and giving them life sciences training, rather than training current employees in technology.

5.5. Institutions have provided training in this area, in particular:

- ELIXIR, an EU funded organisation set up to orchestrate the collection, quality control and archiving of large amounts of biological data produced by life science researchers. Its hub is on the Wellcome Trust Genome Campus in Hinxton, Cambridge. ELIXIR UK plays a significant role in the training landscape across the whole of the European ELIXIR project. They co-lead on the ELIXIR training platform and support the development of training to address key skills gaps amongst UK scientists.
- The Farr Institute, which has developed a number of short courses across the UK designed to equip health data professionals with the skills required for analysing and interpreting complex datasets.13

5.6. ELIXIR UK has also established a Statistics Working Group to consider this skills gap and find ways to address it. This includes developing career related training tools, such as online or short-course training, which might be provided via a web-based portal to increase visibility and access to quality existing training.

5.7. Universities have introduced a number of postgraduate courses, some of which can be studied part time, to help address this skills need.

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13 http://www.farrinstitute.org/events-courses/professional-courses
5.8. Bioinformaticians have been placed on the Home Office Shortage Occupation List, which makes it easier for individuals with these skills to be recruited from abroad.

What did the measures cost and how were they funded?

5.9. The cost of recruitment from the UK, EU and the rest of the world is funded by companies. In many instances companies bring skilled people to the UK through intra-company transfer arrangements.

5.10. The development and implementation of university courses is paid for by the universities. Fees are charged to students to recoup these costs.

5.11. ELIXIR UK is funded by the EU. In 2015 ELIXIR was awarded €19 million from Horizon 2020 to accelerate the implementation of Europe’s life-science data infrastructure.14

What were the results?

5.12. The shortage of data analysts is growing rather than shrinking. Data mining, for example, was not rated in the 2008 ABPI survey, and became a high priority in the 2015 survey. More than 60 per cent of respondents agreed that urgent action is needed, while only around 10 per cent thought it was a low priority area. The survey found that companies had difficulty recruiting across all qualification levels except non-graduates, with all reporting a low number of candidates. The quality of candidates was also considered an issue by most respondents.6

5.13. Bioinformatics was also rated as medium or high priority by 90 per cent of respondents to the 2015 survey. Problems were identified at all qualification levels apart from non-graduates, who are unlikely to be recruited for this area.6

5.14. Statistics was also a very high concern area with only 4 per cent of respondents not identifying it as a high or medium priority. Over 70 per cent of respondents agreed that urgent action is needed to address skills gaps in statistics. This affects recruitment of graduates/MScs, PhDs, postdocs and experienced staff. It was also considered an increasing problem for the future with both the quality and number of graduates available needing to be addressed.6

5.15. However, skills needs are not static and are often most acute for emerging areas, particularly within areas such as data analysis, meaning needs must be continually assessed. The growth of areas which support personalised medicines such as clinical bioinformatics, population genetics and translational informatics is likely to increase the need for these skills.

Recommendations

5.16. The upcoming government industrial strategy and life sciences strategy include specific, targeted measures to address the identified STEM skills gaps in the life sciences sector, in particular focusing on data analysis (informatics, data mining and statistics).

5.17. The skills of the UK data workforce should be developed through:
   - Targeted training and continuing professional development, including the creation of high level apprenticeship training routes,
   - Raising awareness of the wide ranging opportunities in the biopharmaceutical industry, and

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- Creating better links between employers and higher education institutions.
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6. Animal research (pharmacology and physiology) skills

What skills were needed?

6.1. Animal research (often known as in vivo) pharmacology is the study of how medicines interact with living organisms, with the aim of predicting what effects a medicine might have in humans. Animal research physiology is the study of the physical, chemical and biochemical properties of the functions of living organisms. In vivo scientists develop animal models of disease to support research into disease processes and hence the development of new medicines.

6.2. Animal research/in vivo areas were one of the top priorities highlighted by industry in the 2008 ABPI skills gap survey. This is supported by many other studies – a survey by the British Pharmacological Society and The Physiological Society demonstrated that fewer than 2 per cent of graduates of relevant biological sciences received any in vivo education in the UK, while 25 per cent of the academic staff qualified to provide this education and training were due to retire within five years.\(^\text{15}\)

How were they addressed?

6.3. New undergraduate courses were created, designed to deliver increased training in integrative physiology and pharmacology and develop strong experimental skills.

6.4. The Integrative Mammalian Biology (IMB) centres were set up to provide grants to academic centres to build capacity for research training at undergraduate, postgraduate and postdoctoral levels.

6.5. The Integrative Pharmacology Fund (IPF) was set up to support in vivo research and training at UK universities, as well as other training opportunities. The fund has supported in vivo teaching courses, co-funded PhD research students and academic fellows, provided bursaries for MRes programmes with a particular focus on in vivo research, and pump priming grants which enable early careers researchers to pioneer new in vivo techniques and therefore gain other grants.

6.6. The British Pharmacological Society (BPS) and Physiological Society worked together to create short courses in integrative pharmacology and physiology, designed by top in vivo scientists.

What did the measures cost and how were they funded?

6.7. The development of new undergraduate courses were funded by the universities involved. Fees are charged to students to recoup these costs.

6.8. Integrative Mammalian Biology (IMB) cost £12.3M and was funded jointly by the Biotechnology and Biological Sciences Research Council (BBSRC), Higher Education Funding Council for England, Medical Research Council (MRC), Scottish Funding Council, the then Department of Trade and Industry (DTI) and the British Pharmacology Society’s Integrative Pharmacology Fund (IPF), below.

6.9. The Integrative Pharmacology Fund (IPF) cost £4 million and was funded by donations from AstraZeneca, Pfizer and GSK.

\(^{15}\) British Pharmacological Society, "A survey of integrative physiology/pharmacology teaching undertaken by the BPS and The Physiological Society", (2004) pA2 Online Vol. 3 No. 2: 10–11. (Note that ‘in vivo education’ here involved practical work conducted that required a personal licence)
6.10. British Pharmacological Society (BPS) and Physiological Society developed the courses which were part funded through the Integrative Pharmacology Fund. The courses received additional support from the Wellcome Trust, the Medical Research Council (MRC) and the Biotechnology and Biological Sciences Research Council (BBSRC).

What were the results?

6.11. A recent (December 2016) evaluation by the British Pharmacological Society on the Integrative Pharmacology Fund concluded that the initiative ‘successfully increased the capacity of in vivo education, training and research in academic institutions, at least partially off-setting projected losses due to retirement’.\(^\text{16}\)

6.12. This finding was echoed in the 2015 ABPI survey. In vivo areas went from one of the top priorities in 2008 to a medium priority in 2015, in part due to the actions taken set out above. Practical skills were rated as a concern, but not a major one.\(^\text{7}\)

6.13. However, very few people rated these areas as low priority or stated that they are not a problem. In vivo physiology is still a major concern in both quality of and number of candidates. The qualification levels most affected by these problems are graduates/MScs, PhDs and post-docs. Recruitment of non-graduates or experienced staff was not reported to be an issue.\(^\text{7}\)

6.14. The ABPI findings parallel those identified by the Biotechnology and Biological Sciences Research Council (BBSRC) and the Medical Research Council (MRC) in their vulnerable skills and capabilities survey from 2014\(^\text{17}\) which identified concerns about the future supply of individuals with skills to work with whole animals. These findings were also supported by the December 2016 British Pharmacological Society (BPS) evaluation of IPF which reported ‘enduring concerns about the retention of in vivo skills and how best to build sustainability through local investments in people with those skills’.\(^\text{16}\)

Recommendations

6.15. Mechanisms and funding should be found to sustain activities like those which have been shown to successfully address the skills gap, such as programmes provided by the Integrative Mammalian Biology (IMB) centres and joint British Pharmacological Society (BPS) and Physiological Society short courses

6.16. Further efforts should be made to ensure in vivo exposure is included at undergraduate and MSc level, providing a select cohort of undergraduate students with the knowledge, expertise, and skills to be able to undertake integrative physiology and pharmacology investigations, as suggested by Lewis (2012).\(^\text{9}\)

6.17. Recommendations in the British Pharmacological Society evaluation of Integrative Pharmacology Fund (IPF) should be implemented, including continued support for undergraduate programmes and early career researchers, and fostering collaborations across academia, industry and the NHS.


\(^{17}\) Biotechnology and Biological Sciences Research Council (BBSRC) and the Medical Research Council (MRC), ”Review of vulnerable skills and capabilities”, (February 2015). Available from: \url{https://www.mrc.ac.uk/documents/pdf/review-of-vulnerable-skills-and-capabilities/}
7. Clinical pharmacology

What skills were needed?

7.1. Clinical pharmacology provides industry with analysis of wanted and unwanted effects of medicines on patients and clinical trial participants. They have a key role in clinical research and their contribution is essential to improve the success rate of early phase trials.

7.2. Clinical pharmacology/translational medicine was rated a crucial top priority in the 2008 ABPI skills gap survey, as it was in 2005. Specific expertise is needed when developing biological molecules, rather than small molecule medicines.\(^7\)

7.3. In industry both specialist clinicians and bioscientists work in this area, in the NHS and universities employ specialist clinical pharmacology consultants. In 2014 the number of Clinical Pharmacology and Therapeutics (CPT) consultants in the UK was only 77, while the Royal College of Physicians in London has recommended a workforce of 440, one in each large district general hospital and one per 180 training medical students. In the 2015 ABPI survey, clinical pharmacology was still rated as an important area that requires immediate action. A problem with recruitment of experienced staff was also highlighted across all clinical areas.\(^7\) These findings confirm the importance of clinical pharmacology and translational medicine in the UK pharmaceutical industry, the skills shortages in the area and the urgent need for development of a skilled workforce.

How were they addressed?

7.4. Two Clinical Pharmacology and Pathology Fellowship Programmes were created by the Medical Research Council (MRC).

7.5. PhD training fellowships were funded by the Wellcome Trust.

7.6. Translational Research Partnerships (TRP) were developed by the National Institute for Health Research (NIHR) Office for Clinical Research Infrastructure (NOCRI), which aim to increase collaboration between academia and industry and overcome challenges in early clinical development.

7.7. The ABPI, and several of our member companies, have provided opportunities for medical and bioscience students to learn about how medicines are developed and the involvement of doctors and other scientists in clinical pharmacology, through student selected component (SSC) placements, lectures and workshops.

What did the measures cost and how were they funded?

7.8. The Medical Research Council (MRC) Clinical Pharmacology and Pathology Fellowship Programmes cost £3.7 million and were funded by the MRC and pharmaceutical companies, including AstraZeneca, GSK and ICON. The scheme was extended in 2016 with the MRC providing £1.5m, and the Universities of Liverpool and Manchester providing £150,000 each. Partnerships with four major pharmaceutical companies (Eli Lilly, Novartis, Roche, UCB Pharma) have also been formed resulting in each of them committing £300,000 to the scheme.

7.9. The Translational Research Partnerships (TRP) were set up by NOCRI who also provide a dedicated team to act as a single point of contact for companies working with the TRPs. Ongoing funding is provided through clinical studies contracted to the centres.
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What were the results?

7.10. The MRC Clinical Pharmacology and Pathology Fellowship Programmes successfully trained 13 fellows with a focus on personalised medicine and drug safety science. The new 2016 scheme aims to train the same number.

Recommendations

7.11. The 2016 extension of the MRC Clinical Pharmacology and Pathology Fellowship Programmes demonstrates that initiatives like this are valued by industry and academia. Successful programmes like these should be supported with long-term funding.

7.12. Discuss with Health Education England and the Royal Colleges ways in which the pool of clinical pharmacology physicians could be expanded, for instance through offering sub-specialist training in this discipline to specialists in other areas. The clinical pharmacology training should, ideally, include time spent working in a pharmaceutical company.

7.13. Whilst the training of medically qualified clinical pharmacologists should remain a priority, action should be considered on raising the awareness and attractiveness of clinical pharmacology career paths to a wider range of graduates from quantitative disciplines.
8. Core mathematical skills

What skills were needed?

8.1. The core skills the ABPI skills gap report examines are scientific knowledge, high level maths knowledge, application of scientific and maths knowledge, problem solving skills, communication skills, and team-working skills. As well as needing specialists in disciplines such as statistics and informatics, the ability to interpret and understand large sets of data is a key requirement for many scientists, requiring high level quantitative skills. Core mathematical skills were also identified by the Cogent Skills and Science Industry Partnership Skills Strategy 2025 report which stated that “all specialists could benefit from greater mathematical... acumen”.

How were they addressed?

8.2. In September 2014 new level 3 maths qualification, Core Maths, courses were introduced for students who achieve a Grade C (Grade 4 in the new GCSE grading), or above pass at GCSE Maths who are not taking maths A-level. The qualifications are designed to prepare students for the mathematical demands of work, study of other level 3 qualifications, and life. Their development involved employers, universities and professional bodies to ensure they were valuable preparation for higher education and employment.

8.3. The courses support the Government’s plan to increase participation post 16 and raise mathematical standards, and its aim for the majority of students to continue studying maths until 18 years old by 2020.

What did the measures cost and how were they funded?

8.4. The courses were developed in partnership with industry and implementation paid for through the schools system. However recent changes to funding, from per qualification to per pupil, is likely to deter schools and colleges from offering these additional qualifications to their students.

What were the results?

8.5. The courses have not been running long enough to conclusively assess whether or not they will be effective, but the collaborative way in which they were designed in partnership with employers, universities and professional bodies is a good model for design of future courses and looks to have promising returns for students’ skills going forwards.

8.6. There has been a significant increase in the numbers of students taking A-level maths and further maths since the early 2000s. This now seen as less of a problem than it was in 2008; however, it is still a concern and actions to address these needs should be continued and further developed.

Recommendations

8.7. The complete pipeline for the development of appropriate mathematical skills must be considered, including:

- Extending opportunities for students to study maths alongside science subjects post-16,
- Universities increasing emphasis on level 3 maths entry requirements for bioscience courses,
- Universities including quantitative aspects and modules requiring practical use of mathematics at all levels in bioscience courses so as to better prepare students for further study and work in scientific disciplines,
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- Raising awareness and uptake by UK graduates of Masters and PhD level training in statistics, data mining, mathematical modelling and related disciplines.

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