Nesta

Universities UK

ANALYTIC BRITAIN

SECURING THE RIGHT SKILLS FOR THE DATA-DRIVEN ECONOMY

POLICY BRIEFING

July 2015

This joint policy briefing from Nesta and Universities UK draws on two research reports on the state of supply and demand for analytical skills in the UK to make recommendations on how to upgrade data analysis education and skills provision.

CONTEXT

Data is transforming the economy, increasing efficiency and creating new opportunities for innovation. We are constantly generating data, from changes in how we shop, communicate and meet, to the clothes we wear and the gadgets we use, and businesses and government are becoming more adept at creating value from this.

The UK, referred to by some as 'The Connected Kingdom', is particularly well–placed to benefit.[1] But if data is the new oil, logically, it won't be useful to business until refined. That requires analytical skills.

That much has been made clear in recent years by an extensive body of independent research by Nesta into the experience of the 'datavores' – those businesses that make heavy use of data for driving their business decisions – as well as the work of academics and other public bodies like the Tech Partnership.[2] Such research shows a strong link between data, business innovation and productivity. Nesta's new report, *Skills of the Datavores*, finds that data–driven companies are over 10 per cent more productive than 'dataphobes' – firms that don't exploit their data – controlling for other determinants of productivity.

However, the data–driven companies we have surveyed are struggling to find suitable talent. Two–thirds of datavores who tried to recruit analysts in the previous 12 months struggled to fill at least one vacancy. A recent employers survey by the Tech Partnership shows that big data analytics is the tech occupation with the biggest skills gaps.[3] While data may be part of the answer to the UK's productivity gap with other countries, it appears that barriers to accessing analytical talent are preventing businesses from fully harnessing its potential.

By and large, the problem is finding people with the right *mix* of skills: the data scientists who combine technical skills, analytical and industry knowledge, and the business sense and soft skills to turn data into value for employers are very hard to find – so much so that some people refer to them as 'unicorns'.[4]

In the absence of such unicorns, businesses are building their analytical capability through multidisciplinary teams. Members of a team may have a number of core skills in common, and individuals will have specialist skills developed within particular disciplines. This underscores the need not just for multidisciplinary working, but for data analysts with strong teamwork and communication skills.

In recognition of this skills shortage, Universities UK has undertaken research into how data skills are taught in undergraduate degrees across subject areas. We find that training in data analytics is found in most STEM and social science courses, but the extent of provision varies by institution and degree subject. To meet the current and future needs of the UK economy, we must do more to embed data skills as a core component of more degree programmes.

ABOUT OUR RECOMMENDATIONS

The recommendations in this briefing span the whole analytical talent pipeline, including schools, colleges, universities and the labour market and industry. The recommendations aim to remedy skills shortages in the short term, while ensuring a sustainable supply of excellent analytical talent in the longer term. Additionally, the recommendations encourage cross-sector collaboration so that knowledge about how to create value from data and awareness of analytical skills shortages are not trapped in siloes, but are widely shared.

The data revolution has implications not only for experts with advanced analytical skills (i.e. data scientists), but for the entire workforce. We all need to become more data literate to operate successfully in increasingly 'data-rich' environments. This is a key lesson from *Count Us In,* the British Academy's review of the UK landscape for quantitative skills.[5] Our recommendations reflect the diversity of analytical skills levels which are needed, and also suggest creating early 'touch points' between young people and data, acknowledging that in some cases these will mark the beginning of a life-long analytical career, while in others it will involve raising awareness and confidence in using data, whatever the occupation.

Regarding the overall scope of our recommendations, our assessment of the current situation in the analytical talent pipeline is broadly optimistic. The data revolution has created analytical skills shortages, which are being particularly felt by those companies that are most innovative with their data, but there is a rapidly increasing awareness of those issues, and a willingness by educators and the government to act upon them. Much good work is already taking place in schools, universities and skills development agencies. The challenge therefore is to step up significantly the response so that it is commensurate with the scale of the opportunities. Our recommendations set out to adapt, repurpose and prioritise existing initiatives and programmes, rather than overhaul them.

This is what we are calling for:

SCHOOLS AND COLLEGES

1. **We need stronger teaching of mathematics and statistics in schools and colleges**

   The pipeline of data talent starts in schools, where we need to ensure that the teaching of analytical skills is embedded across curricula, and that, consistent with the Government's ambition, more young people study mathematics and statistics after the age of 16. Regarding the mathematics curriculum, **we endorse the policy agenda set out by the Royal Statistical Society (RSS) in its *Data Manifesto* where it is suggested that we need to prepare for the data economy by skilling-up the nation in maths and statistics**. As the RSS recommends, basic data handling and quantitative skills should be an integral part of the taught curriculum across most A-level subjects. The new Computing curriculum in English schools is a significant development, but it needs to be supported by sustained investment in teacher training.[6]

   Initiatives like the Department for Education's (DfE) extension of the Further Maths Support Programme to boost mathematics participation and provision by providing advice, guidance and teacher training, and the extension of funding for the Network of Excellence programme in Computing teaching until March 2016 are also important. The same is true for the development of Core Maths to ensure a greater uptake of mathematics post-16 beyond the 20 per cent that currently study it after their GCSE.

2. **More and better information about analytical career prospects and role models in schools and colleges**

We need to improve access to information in schools and colleges about the career opportunities for data analysts, and identify and promote appropriate role models. Otherwise, young people may be disinclined to pursue a career in data analysis despite the rich career prospects.

The Tech Partnership provides a wealth of information about digital careers. In particular, its TechFuture initiatives (including TechFuture Careers, TechFuture Girls and TechFuture Classroom) bring together practical lesson guides, group activities and industry experience to educate students about the types of tech jobs available and the paths they need to follow to get them. Data analytics occupations could have a stronger presence in these initiatives, in particular focusing on the range of sectors and organisations utilising data analytics.

We call on the Tech Partnership to further highlight data analytics as a great career in the TechFutures Programme, and build up resources to support its teaching. We also recommend convening a workshop including the recently established careers and enterprise company for schools, employers and local authorities (including teaching and management staff) to identify the best ways to embed data skills in schools across all subject areas, and make the link to careers in data analytics in a way that captures the imagination of young people – and their parents/carers.

We also need to create more data analyst role models in schools, using networks of practitioners such as STEMNET (especially through the Tech Partnership's TechFuture Ambassadors network). There should be a drive to attract analysts who are deploying STEM skills to analyse data in commercial contexts, and in sectors such as retail and creative media, as well as traditional science and tech industries. Finding a range of role models will also contribute to diversity, and help reduce the gender gap in the profession.

3. **Embed data analysis in other subjects**

There is much scope to embed data analysis in school subjects other than mathematics and statistics. For example, the Urban Data School, run by the Open University in collaboration with Milton Keynes schools, develops data skills in young people by enabling them to use open and big datasets, such as energy, transport and satellite data, to analyse local issues. The benefits to students include an increased understanding of the use of this data and its impact, and data analytic and visualisation skills.[7]

The Urban Data School is currently developing pedagogical resources, an online platform for sharing data and good teaching practice, and a network of teachers engaged in data analytics and visualisation. **The Government should keep a watching brief on innovative initiatives like the Urban Data School, and consider potential interventions to support their expansion where they are shown to have a beneficial impact. Local government should make these initiatives more attractive by opening up local datasets for students to work with**. Giving students the opportunity to use data to understand – and even make a difference – in the environment around them is after all an excellent way of engaging them with data. It can also have significant benefits to local authorities as they rethink services aimed at young people, and, through 'reverse mentoring' can even help build capacity within the local government workforce.

4. Support the development of extracurricular data activities

Extracurricular and afterschool activities can help bring data and analysis to life for young people, and highlight the extent to which data now plays a central role in a wide range of industries, some of which – like retail and creative media – have not traditionally been seen as recruiters of analytical talent.

To make more of this happen, **the Skills Funding Agency should fund an experimental Data Summer Schools pilot in collaboration with industry, schools, colleges and universities to give more students the opportunity to engage with data, and develop their hands–on data skills. This would be aimed at students who require additional preparation for university study, or employment (including through Apprenticeships).**

For students who do not take a specialist data analytics course at university, or for those pursuing an alternative vocational route, the Data Summer School will provide guidance on embedding these skills in other disciplines and across industries, developing domain knowledge, and team working.

This scheme should be closely aligned with the Trailblazer Apprenticeship standard for Data analysts and, as such, provide the skills and guidance that students need to enter the labour market, pursue further study, or embed data analytics skills in other disciplines.[8]

UNIVERSITIES AND VOCATIONAL EDUCATION

1. Increase the visibility of strong data analytics courses

The technical skills required to analyse data can be developed in a number of different degree programmes. Research undertaken by Universities UK suggests that this is not always made clear, both to prospective applicants and employers. More needs to be done to verify the extent and professional relevance of data analytics skills in university courses in the UK. **We recommend a kite–marking scheme, developed by the Tech Partnership and the Royal Statistical Society to identify relevant courses to prospective applicants and employers, based on input from the breadth of industries being transformed by data**. Importantly, this should consider vocational courses as well as undergraduate ones, and draw on relevant information, such as the latest IT professional standards.

2. Embed quantitative analysis across disciplines

Many of the companies we surveyed in our research said they were concerned about insufficient domain (industry) knowledge in the analytical talent pool. An implication of this is that, in addition to setting up specialist data science courses focused on technical skills, universities should build on existing programmes and find new ways to embed analytical, computing and visualisation skills in them. We find that the higher education sector has led a number of initiatives to meet this challenge.

The Q–step initiative in particular is addressing this issue for the social sciences. Funded by the Nuffield Foundation, Economic and Social Research Council (ESRC) and the Higher Education Funding Council for England (HEFCE), Q–step aims to address the shortage of quantitatively–skilled social science graduates through 15 Q–step centres. The Q–step centres support the development and delivery of specialist undergraduate programmes, including new courses, work placements and pathways to postgraduate study. We suggest that Q–step should be considered as a model for other funders to support, and further, **that Research Councils UK (RCUK) explore additional funding to support methodological and skills development in analytics so that the Q–step model can be extended to other disciplines**.

Universities themselves need strong data analytics practitioners, both to support research across disciplines and to educate tomorrow's graduates. We find that the current research funding model has led to the concentration of disciplines in particular universities. **We recommend that RCUK maps data analytics capabilities across universities and assess whether more needs to be done to address potential skills shortages within universities**.

3. Boost the business and soft skills of graduates from data analytics courses

Data analysts apply theoretical knowledge and hands-on technical skills in commercial environments, often as part of multidisciplinary teams. To speed up and smooth the transition of graduates from data courses into the commercial and public sectors, **we propose that a graduate data skills accelerator programme should be convened by university/industry partnerships across the UK, tapping into the experience and expertise of university–industry brokers like Pivigo and The ASI.**

There are opportunities to develop additional pathways to higher level skills in data analysis, such as degree apprenticeships, which combine academic education with work in industry. There are currently 13 such degree apprenticeships, including one in 'Digital & Technology Solutions'. Designed by employers of tech talent in all sectors and supported by the Tech Partnership, this degree apprenticeship includes a common core of technology skills with options relevant to six different occupational areas, including data analyst.

Our recommendation is that relevant stakeholders actively promote the data analyst degree apprenticeship option, encouraging employers to offer it and young people to apply for it.

Our research has shown the importance of team diversity and multidisciplinary collaboration in analytical work; however, this is not so easy to simulate within traditional undergraduate programmes, delivered by a single academic department. The challenge is similar to that faced in courses feeding talent to other innovative sectors, like videogames.[9] In order to encourage more multidisciplinary collaboration in that industry, Abertay University put in place its Dare to Be Digital Competition, where teams of university students from different disciplines (coding, arts, and design) compete for the opportunity to win a BAFTA prize.[10] We think that the same model could be used in data analytics, encouraging students with different analytical skillsets (e.g. programming, statistics, domain knowledge and data visualisation) to build an innovative product, or address a challenge using data. **Universities with a strong presence in the analytics space should consider organising this prize as a pilot, possibly in collaboration with the Alan Turing Institute and a high visibility big data conference like O'Reilly Strata**.

4. Increase the supply of high-end analytical talent

Demand for highly-educated data analysts is acute, both in research and development and in business more generally. This demand is two-fold: first, for practitioners capable of engaging with the current state of the art; second, for practitioners capable of developing new techniques and methods. In addition, universities need highly-educated staff to lecture future generations of analytical talent.

Centres for Doctoral Training (CDTs) bring together diverse areas of academic expertise to train engineers and scientists with the skills, knowledge and confidence to tackle today's evolving issues. The Engineering and Physical Sciences Research Council (EPSRC) has recognised the challenge that data analytics brings through the funding of dedicated CDTs that train analysts with cutting-edge skills. The further commissioning of a CDT by

the ESRC in New Forms of Data is also a positive and major step forward. **We support the approach of the research councils to this challenge, and suggest that the Government devise a funding model for the expansion of such initiatives where they prove to be successful in meeting current and future needs.**

5. Foster interdisciplinary research and skills development programmes

Many breakthroughs in the development of analytical methods and tools have happened at the intersection between different disciplines. An implication is that we need to support interdisciplinary, innovative research projects involving advanced data analytics, statistics and quantitative skills, and that calls for cross–research council collaboration and funding. **Our recommendation is for a top slice of the RCUK budget to establish a strategic fund through which interdisciplinary research is funded. RCUK could itself take a strategic and convening role in this space.**

Skills development programmes are another area where a more joined–up approach would serve researchers better than initiatives conducted in silos. RCUK, working with individual research councils, has already taken steps to realise this. We note the work that RCUK has undertaken to facilitate a policy network on data and its applications, as well as networking opportunities for researchers from different disciplines to share best practice, and encourage the expansion of this activity.

LABOUR MARKET AND INDUSTRY

1. Create a cross–cutting taskforce around data analytics

There are currently many agencies in the UK exercising leadership to address the skills shortages arising in industry from the data revolution. However, no single body has all the answers to what are system–wide challenges. Collaboration is needed to address the national challenges we have identified in our research.

We call on relevant stakeholders, including the Tech Partnership, the Royal Statistical Society, the UK Commission for Employment and Skills, the E–Infrastructure Leadership Council, the Digital Economy Council, techUK, the ODI, HEFCE and the research and sector skills councils to set up a cross–cutting taskforce around data analytics to identify good practices for education and skills provision, and spur collaboration across industry.

2. Actively convene industry analytics networks

Our research has demonstrated the potential value of industry crossover in data applications and talent flows, some of which is being realised at the grassroots level: at data analytics events, meetups and hackathons.

We believe that UK universities can play a stronger role in convening such events, potentially making space freely available to their organisers. Not only would this support skills upgrades in the local analytical community, but it would also strengthen local analytical networks, including those between universities and analysts in industry and government, and those between academic researchers doing analytical work in different university departments. By working with local public services and communities, such data partnerships could help support public service transformation and build analytical capacity within civil society.

These grassroots activities could be usefully complemented by a higher visibility network following the example of an organisation like the US National Consortium for Data Science, or Scotland's Data Lab, a £11.3 million initiative supported by the Scottish Funding Council, Highlands and Islands Enterprise and Scottish Enterprise, which *"enables new collaborations between industry, public sector and universities driven by common interests in the exploitation of data science, provides resources and funding to kick–start projects, deliver skills and training, and helps to develop the local ecosystem by building a cohesive data science community."*[11]

We think that a data science network along these lines should be developed with involvement from existing communities of analytical practice, the Alan Turing Institute, the Data Lab, the Catapults, and major Data Science institutes at universities like Imperial College, UCL, Manchester and Warwick.

3. Support innovative interventions enabling local authorities to boost local analytical skills

Local authorities and Local Enterprise Partnerships (LEPs) can play a role in upgrading the analytical capabilities of the economies and digital clusters around them, not least through the release of open data. Two examples of this include the Silicon Abbey initiative in St. Albans (a social enterprise partnering with the University of Hertfordshire, Oaklands College and the local authority, aimed at building digital capacity in St. Albans through opening up data sets, training, internships and placements, mentoring and hack days), and the Connecting Data Programme (where Bath and North East Somerset Council, Bath University and Bath and North East Somerset CCG (NHS) are, through collaborations, hacks and multidisciplinary projects, working with communities, academics and public service organisations to bring analytical capabilities to a wider audience and increase local analytical capacity.)

We call on the Department for Communities and Local Government (DCLG), through its Public Service Transformation Network, to convene a workshop to bring together local government analysts and others with an interest in this work to discuss and promulgate good practices. DCLG should consider financially supporting the wider roll–out of promising initiatives (for example, the Connecting Data project was initially supported by DCLG's Transformation Challenge Award.)

These interventions would build on the Cabinet Office's 2015 Open Data Champions initiative, which highlighted the role of 16 Local and Regional Councils as data pioneers that are leading in opening up their data to create opportunities for innovation, economic and social growth and better public services.

4. Raise awareness of the value of data for business

A third of the companies we surveyed in Nesta's research – 'the dataphobes' – displayed low levels of data activity, in spite of its benefits for innovation and productivity. While we feel that other skills interventions might be premature for these organisations, we need to look for ways to encourage them to explore the opportunities of data, and build up their analytical capabilities.

We call for a targeted campaign in the Government's Great Business website to raise awareness about the value of data for business.[13] The website should also provide information about ways in which 'dataphobe' businesses can start building their analytical capabilities. Local Growth Hubs that act as a meeting point for business and support and advice providers can also help to raise business awareness of data as a driver of growth, and provide leadership and management training to encourage its use.

In doing this, it's worth paying attention to the experience of an organisation like techUK which has been leading a series of business–focused seminars exploring the value of big data analytics in key sectors, and DataKind, which has already developed effective models to boost impactful data use in charities.

5. Deliver innovative solutions for data analytics training

Nesta's research suggests that while many companies are up–skilling their analytics workforce intensively, there remain serious gaps to be addressed. One particular challenge is to combine technical, analytical, teamwork and communication skills, and industry knowledge and business nous in one individual. **The UK Commission for Employment and Skills could usefully organise a competition as part of its Futures Programme with the goal of developing innovative models to address the challenge of upskilling analytical workers in the UK.**

As our research shows, data analysts are harnessing innovative learning models based on peer–to–peer learning, Massive Open Online Courses (MOOCs) and online communities to keep their skills fresh in the face of a rapidly changing technology landscape. The recently founded European Data Science Academy (an EC–funded project with involvement from the Open University, University of Southampton and ODI) is also seeking to do this. We think that many of these tools and platforms could play a role in the innovative solution delivered by the competition we are calling for. The Futures Programme competition could also challenge businesses to consider the ways that they organise their work and designs job roles to make best use of multi–skilled teams. It is important to develop the right skills but also to ensure that the workplace is organised in such a way as to effectively utilise and capitalise on the skills developed.

The Tech Partnership's Training Fund, which co–funds employee tech training is also helping to upgrade the data analytics skills of the UK workforce, particularly among SMEs. This fund has, in the year to March 2015, supported training for 1,400 people in 200 businesses. Through the fund, employers can focus on those skills areas that are a priority for them (including big data), using those training options that are most relevant. **More should be done to improve the visibility of the fund as a mechanism to upgrade analytics skills (particularly among non IT/tech firms), and the Government should consider options to extend it after the funding runs out in 2016.**

CONCLUSION

The all–pervasive reach of the data revolution explains why a variety of disciplines and skills need to come together if the UK is to fully benefit from it. As a system challenge, it can only be addressed with a systemic programme of actions like the one we set out in this policy briefing. We believe that if our recommendations are acted upon as a group, they will make the UK a stronger analytic nation, best placed to assume a leading role in the data economy.

SUMMARY OF TOPLINE RECOMMENDATIONS

AREA	TOPLINE RECOMMENDATIONS
SCHOOLS AND COLLEGES	1. Stronger teaching of mathematics and statistics in schools and colleges 2. More and better information about analytical career prospects and role models in schools and colleges 3. Embed data analytics in other subjects 4. Support development of extracurricular data activities
UNIVERSITIES AND VOCATIONAL EDUCATION	1. Increase the visibility of strong data analytics courses 2. Embed quantitative analysis across disciplines 3. Boost the business and soft skills of graduates from data analytics courses 4. Increase the supply of high–end analytical talent 5. Foster interdisciplinary research and skills development programmes
LABOUR MARKET AND INDUSTRY	1. Create a cross–cutting taskforce around data analytics 2. Actively convene industry and community analytics networks 3. Support innovative interventions enabling local authorities to boost local analytical skills 4. Raise awareness of the value of data for business and local public services 5. Develop innovative solutions for data analytics training

ENDNOTES

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9. NESTA (2011) 'Next Gen: Transforming the UK into the world's leading talent hub for the video games and visual effects industries. A Review by Ian Livingstone and Alex Hope.' London: NESTA.

10. See: http://www.daretobedigital.com/

11. See: http://data2discovery.org/

12. Such as the Bath:Hacked Open Data CIC. See: http://www.bathhacked.org/

13. See: http://www.greatbusiness.gov.uk/

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