Supporting STEM education in England

A reflection on strategies to improve the uptake and progression of young people to STEM study and careers.

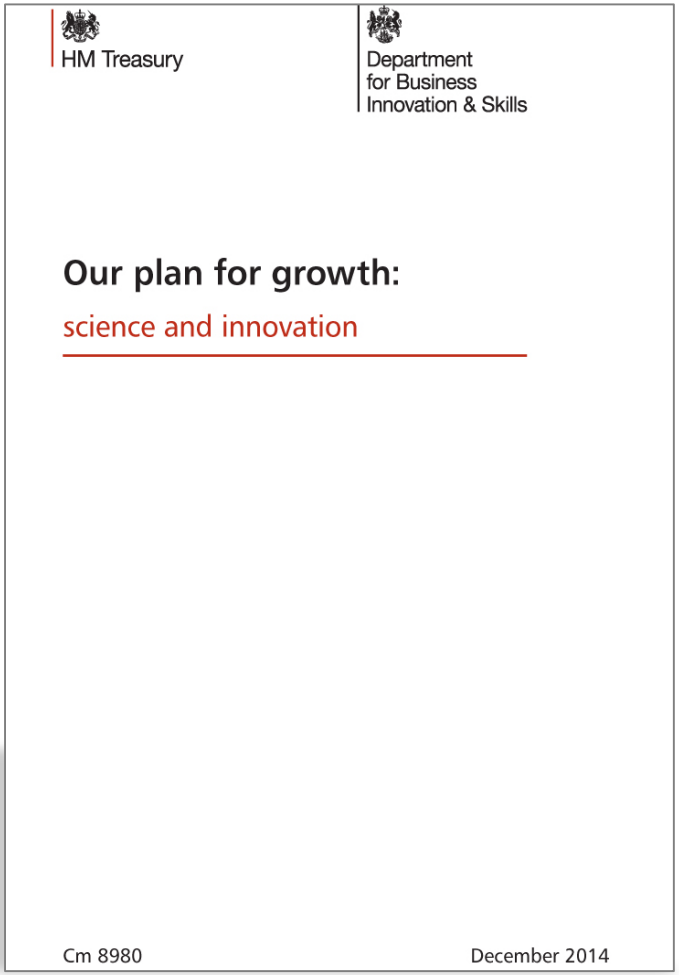
Pauline Hoyle

Director: Cinnabar Consultancy

Outline of talk

1. Review of STEM support in England/UK to support uptake of STEM study/careers
2. Support for teachers
   National STEM Learning Centre and Network (UK)
3. Evidence of Impact

UK government strategy for STEM

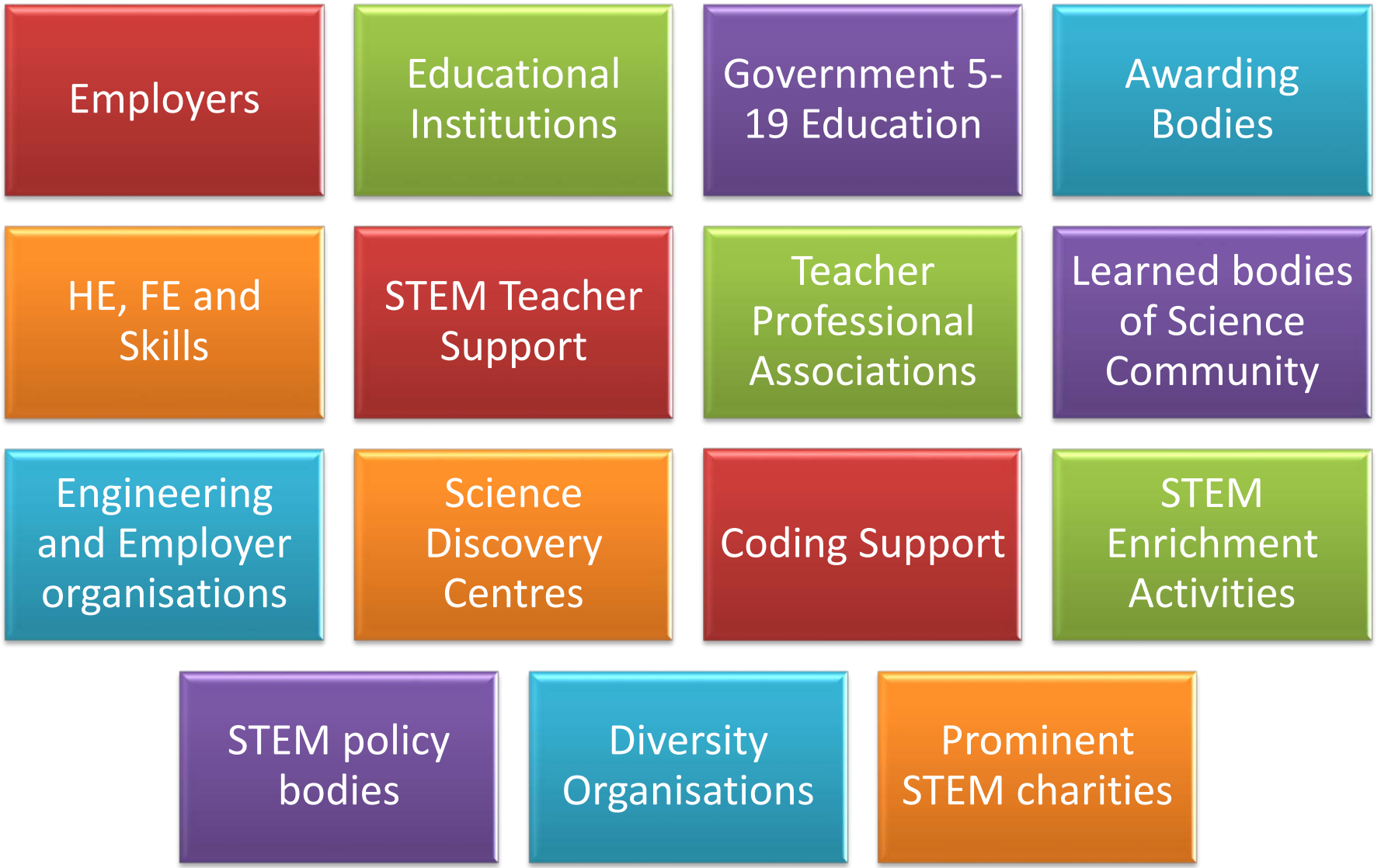


Science & Innovation
Investment Framework 2004-2014
Education Commitments

To Improve

- the quality of science teachers and lecturers in every school, college and university, ensuring national targets for teacher training are met
- the results for students studying science at GCSE level
- the numbers choosing science, engineering and technology subjects in post-16 education and in higher education
- the proportion of better qualified students pursuing research and development careers
- the proportion of minority ethic and women participants in higher education

STEM Stakeholders UK

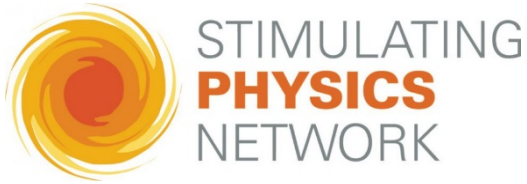


Outline of talk

1. Review of STEM support in England/UK to support uptake of STEM study/careers
2. **Support for teachers : National STEM Learning Centre and Network (UK)**
3. Evidence of Impact

Current funded STEM support

Managed by MEI
Innovators in Mathematics Education



National Science Learning Centre and Network http://www.stem.org.uk
Core Maths -. http://www.core-maths.org/
Maths Hubs NCETM www.ncetm.org.uk
The Further Maths Support Programme http://www.furthermaths.org.uk/
Network of Master Teachers in computing http://www.computingatschool.org.uk
STEM Ambassador http://www.stemnet.org.uk/ambassadors/
Stimulating Physics Network http://www.stimulatingphysics.org/
Your Life campaign http://yourlife.org.uk/
STEM out-of-school clubs http://www.stemclubs.net/

STEM Learning

STEM Learning is an initiative of the White Rose University Consortium (comprising the Universities of Leeds, Sheffield and York) and Sheffield Hallam University.

Our work is made possible by the generous support of the Wellcome Trust, Gatsby Charitable Foundation, the Government, our partners in Project ENTHUSE and other funders of related STEM projects.

STEM LEARNING

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National STEM Learning Centre

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The National STEM Learning Network

- Professional development nationwide -25,000 days per year
- 30,000 STEM Ambassadors from more than 2,500 employers

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Who we work with

- School, college and university staff
- Young people
- Informal educators and leaders of community and voluntary groups
- STEM Ambassadors
- Employers, government and charities

Outcomes

Improvements for teachers, support staff and informal educators in their:

- STEM subject and pedagogical understanding
- confidence, motivation and enthusiasm for STEM subjects
- competence and quality of leading, teaching or supporting STEM subjects
- understanding how to contextualise the curriculum with cutting-edge STEM knowledge, employability skills and STEM-related careers information
- retention and career progression

Increasing STEM Ambassadors':

- professionalism, communication, team working, organisational, mentoring, leadership, delegating and relationship management skills
- understanding of education and how to inspire young people in STEM
- retention in a STEM-based career

Helping employers to:

- develop an enthusiastic, motivated and skilled STEM-based workforce
- access an increasingly competent pool of young people with employability and STEM skills with the potential to become future employees
- better inform young people and parents about STEM career pathways and the employment opportunities available with STEM employers

Increasing young people's:

- engagement, interest, enjoyment and achievement in STEM subjects
- development of employability and practical skills
- post-16 pursuit of STEM subjects and progression into STEM-related study and careers

Vision

To achieve a world-leading STEM education for all young people across the UK

What we facilitate

STEM inspiration activities and CPD for staff

- face-to-face and online CPD
- study visits and placements with R&D institutions, employers and academia

Resource engagement

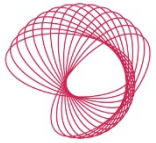
- physical and online curated resources focussed on STEM subjects
- cutting-edge research collections
- STEM careers information and curriculum guidance

STEM enrichment and engagement activities for young people and families

- practical activities, experiments, technical advice
- STEM-based competitions and challenges
- extra-curricular STEM Clubs
- careers talks, careers fairs, mock interview practice
- information, advice and guidance on routes into STEM careers
- work experience, mentoring or shadowing placements with STEM employers

Network of STEM experts: STEM Ambassador Hubs, Science Learning Partnerships, partners in SWANI, employers and supporters

Employer support



ENTHUSE
CHARITABLE TRUST

Department
for Education

STEM LEARNING
STEM | Insight

wellcome trust

GATSBY

The Scottish
Government
Riaghaltas na h-Alba

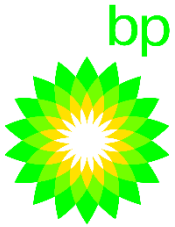
BIS
Department for
Business Innovation
& Skills

Department
for Education

wellcome trust

BIOCHEMICAL
SOCIETY

BAE SYSTEMS



bp

The Institution of
Engineering and Technology

Institution of
MECHANICAL
ENGINEERS

Rolls-Royce

IBM

The Institution
of Structural
Engineers

THE ROYAL
SOCIETY

CPD

Residential CPD
Local CPD
Online CPD
STEM Insight
Bespoke CPD

ENTHUSE PARTNERSHIPS

ENTHUSE Partnerships

ENRICHMENT

ESERO-UK
Polar Explorer Programme
STEM Clubs
Cutting-edge science

STEM AMBASSADORS

Online training
STEM Ambassador Hubs
Volunteer
Invite a STEM Ambassador

CAREERS SUPPORT

Careers toolkit
Online careers resources

RECOGNITION

Awards and recognition

RESOURCES

Resource Centre
Online resources
Community resources
STEM Learning magazines
Networking groups

OUR IMPACT

Impact and evaluation
CPD impact toolkit

RESEARCH

Research reports
Science Capital
Action research

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CPD Programme

Aims to:

- Enhance teachers subject content and pedagogical content knowledge
- Develop skills and confidence within teachers to deliver inspirational practical activities
- Provide examples of research work to support learning in the classroom through cutting edge science /STEM research
- Support teachers in meeting the demands involved in the delivery of the constant curriculum and assessment changes
- Support leaders to lead their teams through change of the new curriculum and beyond

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Facts and figures

We reach

100%

of UK secondary schools, post-16 and FE colleges, and 75% of primary schools work with us

We inspire

2 million

young people benefit from 20,000 teachers taking part in our expertly led, professional learning programmes each year

We impact

90%

of young people increase their engagement in STEM after working with STEM Ambassadors

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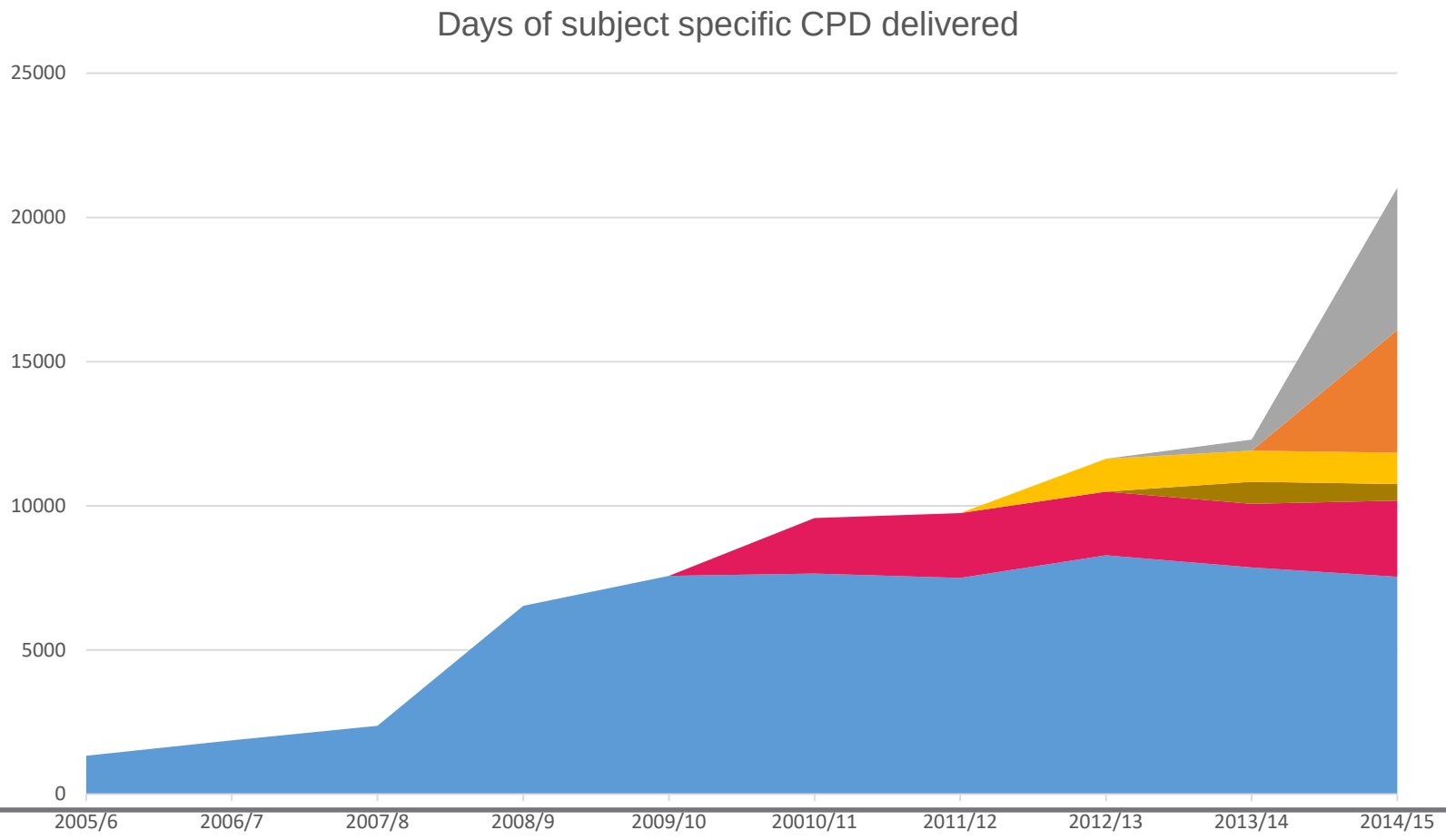
Facts and figures

- around 27,000 days worth of CPD are delivered yearly throughout the Network

- 30,000 STEM Ambassador volunteers representing around 2,500 employers take part in over 50,000 activities with schools, colleges and other young people's groups annually

Developing Provision at Centre



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Project ENTHUSE 2015-16 included

- bursary funded, face-to-face CPD for 2,887 teachers and technicians
- 9,250 UK teachers engaging in online CPD
- 60 teachers/lecturers undertaking STEM Insights placements with employers & Universities
- 38 ENTHUSE Partnerships; 248 schools and colleges (201 primary / 47 secondary) focussing on under-represented groups
- **engaging up to 1.1 million young people with STEM through their teachers and school leaders**

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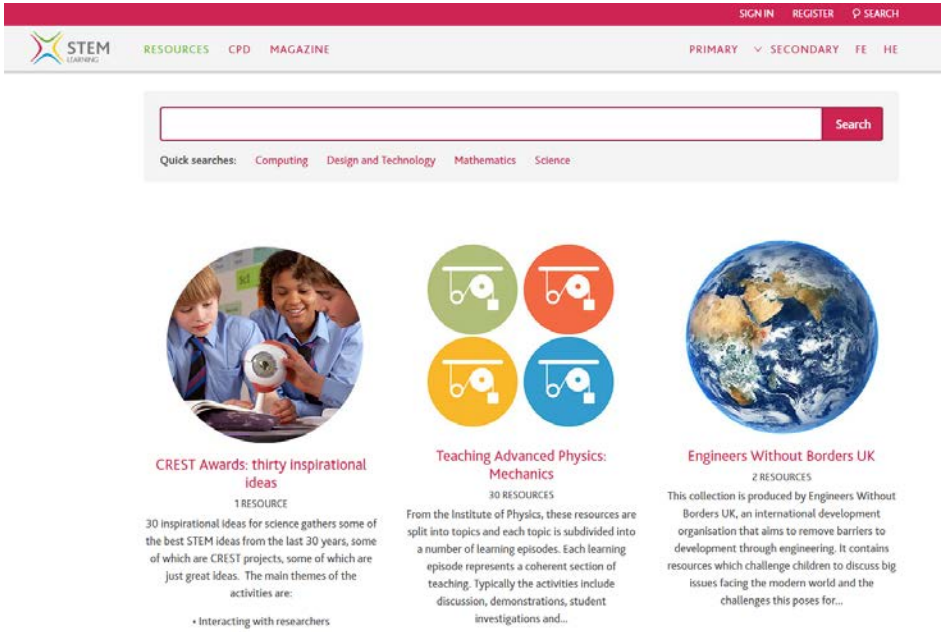
Online resource collection

- more than 11,000 resources
- free to download
- classroom activities, guidance, policy, research
- print, multimedia, interactive and practical
- curated collections linked to subject, curriculum and careers
- quality assured
- tried and tested



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Careers advice and guidance

- STEM Insight
- embedded with CPD
- careers toolkit
- resource collections
- careers community
- Ambassadors

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"82% of teachers think they are lacking the necessary knowledge to properly advise young people…. one-fifth of parents admitted they believe they are out of their depth when it comes to talking to their offspring about career prospects."

AoC 2012

STEM Insight

lifting the lid on STEM careers for teachers

Insight | into industry

During a placement, develop your knowledge of STEM careers and routes for your students to progress into STEM-related employment. Work with world-leading employers across a range of STEM industries such as manufacturing, engineering, medical, computing and many others.

Insight | into university

Spend time in a leading UK university and learn about the latest cutting edge research in your field. Support your students as they make the transition to university.

Outline of talk

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10 Years of Impact

Lessons in Excellent Science Education

www.stem.org.uk/impact-and-evaluation

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www.stem.org.uk/impact

Impact of the Network

Five lessons learnt from subject-specific CPD

1. improves teaching and learning and increased uptake and achievement in science
2. Improves teachers' subject and pedagogical knowledge, skills and confidence and better outcomes for young people
3. develops strong leadership in science, from primary to post-16, benefiting teachers, schools and young people
4. helps recruit and retain excellent teachers
5. enriches teaching, supporting young people's engagement, progression and awareness of STEM careers

Lesson 1

Sustained engagement of schools with Network support is associated with improved teaching and learning, as well as increased uptake and achievement in science.

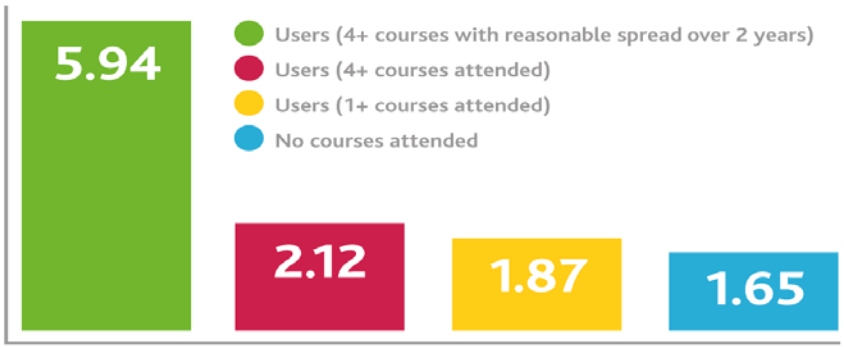
Teachers' participation in Network programmes was *'associated with improved teaching and learning, and higher take-up and achievement in science at their school*'.

National Audit Office, 2010

Evaluation of the impact of NSLN CPD on schools

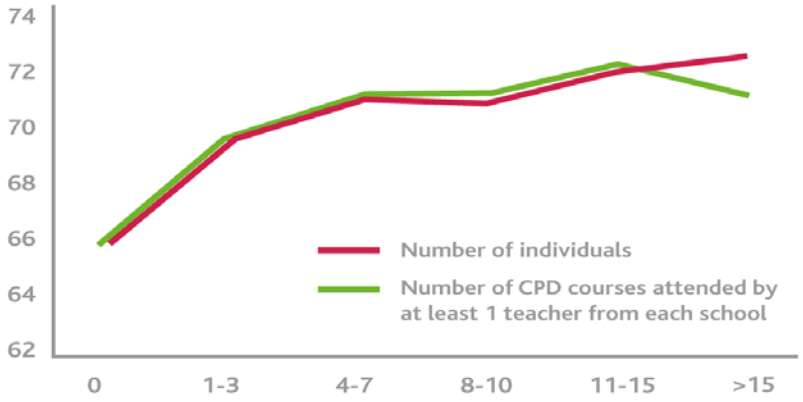
The Isos study also confirmed impacts on pupil progress and attainment:

Improvements in percentage achieving L4+ at KS2 science, 2012-2014



Primary schools that have engaged with Network support start, on average, from a lower base of science attainment than other schools but improve more rapidly and show higher value added than other schools.

Percentage of pupils achieving EBacc 2 Science A*-C in 2014



Secondary schools that engage moderately or highly with Network support achieve higher percentages of pupils attaining two or more science GCSEs and achieve a higher value added score in science.

Source: *Evaluation of the Impact of National Science Learning Network CPD on Schools.* Isos Partnership, 2015.

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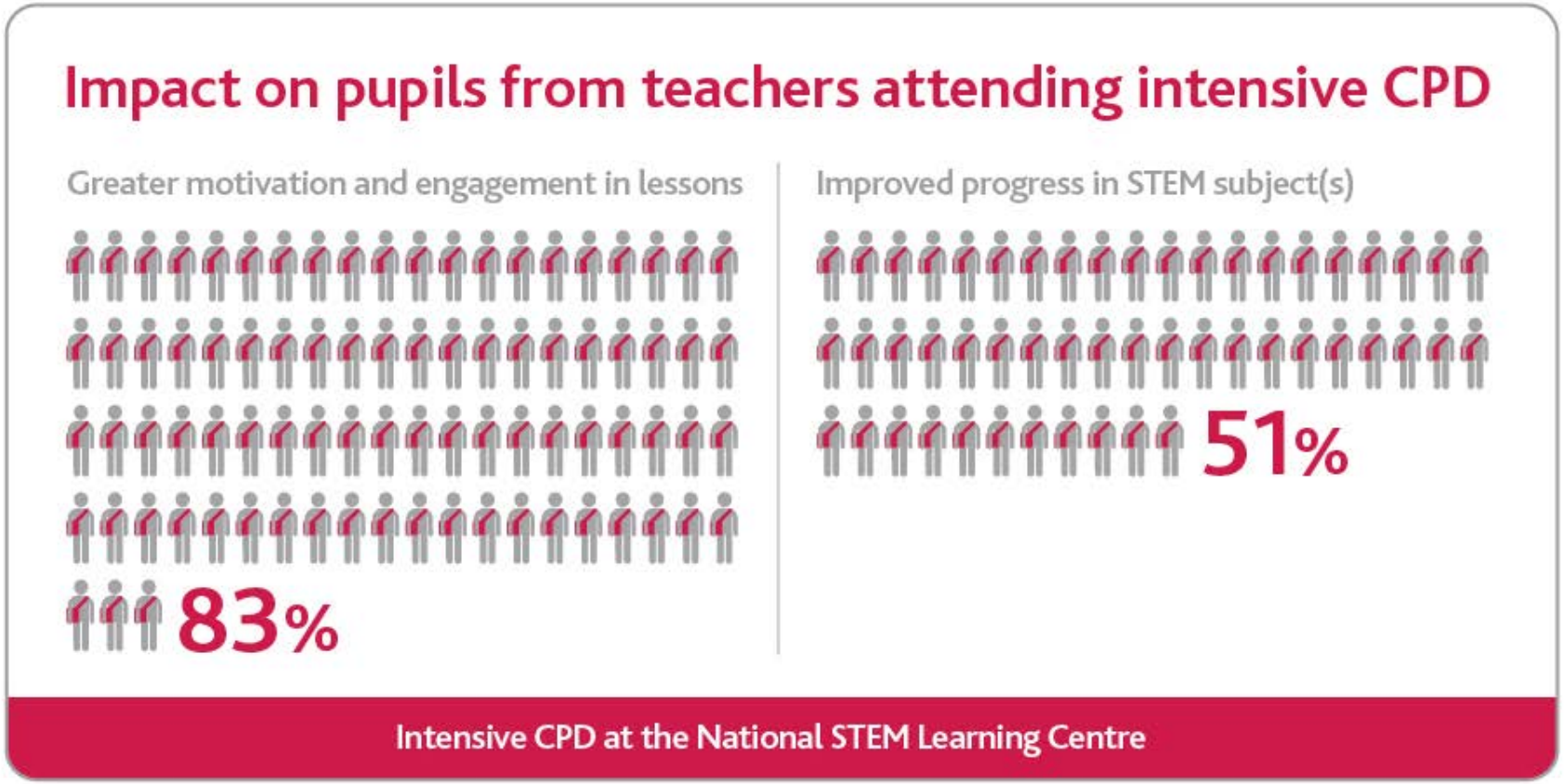
Internal self evaluation



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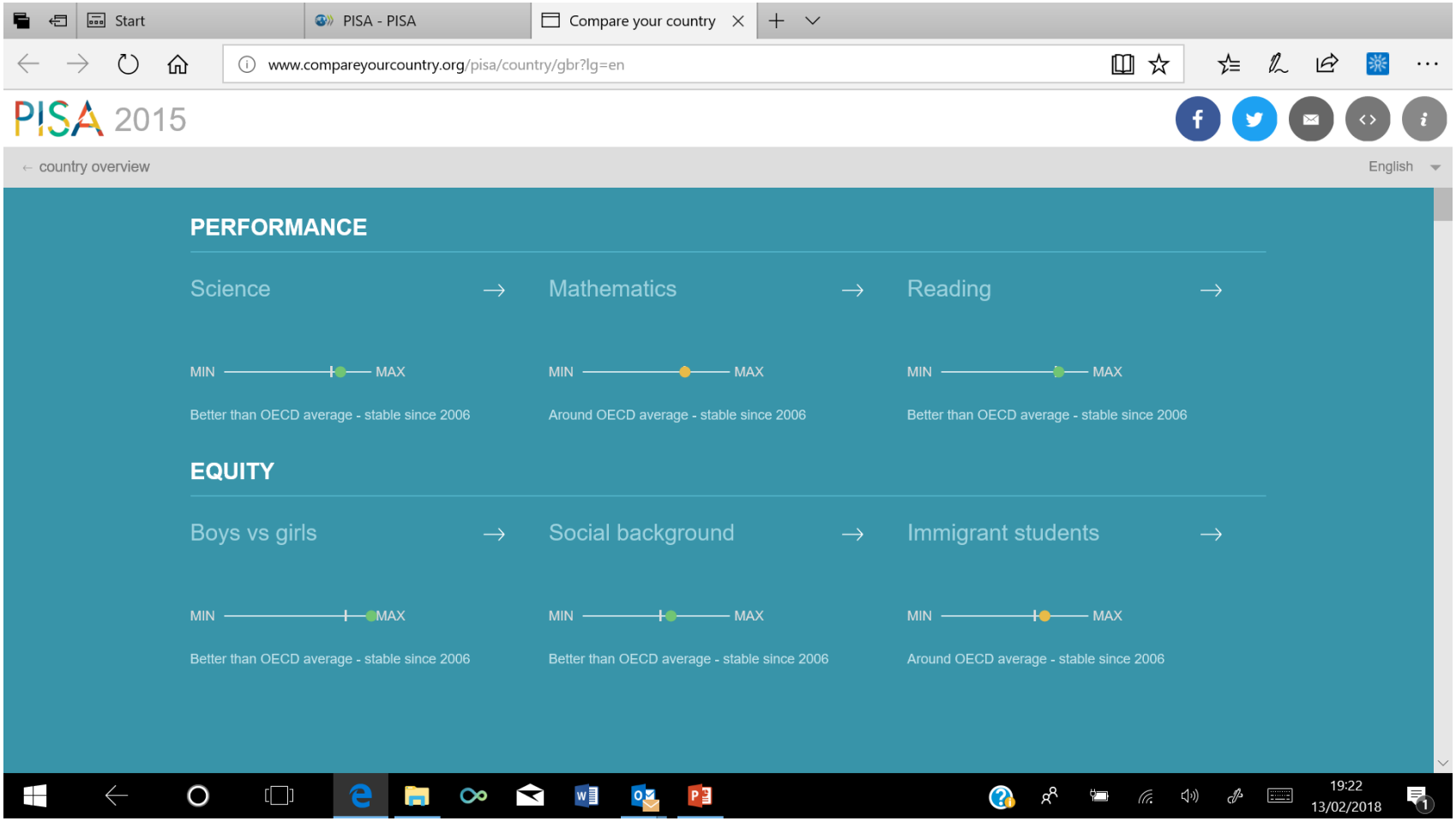
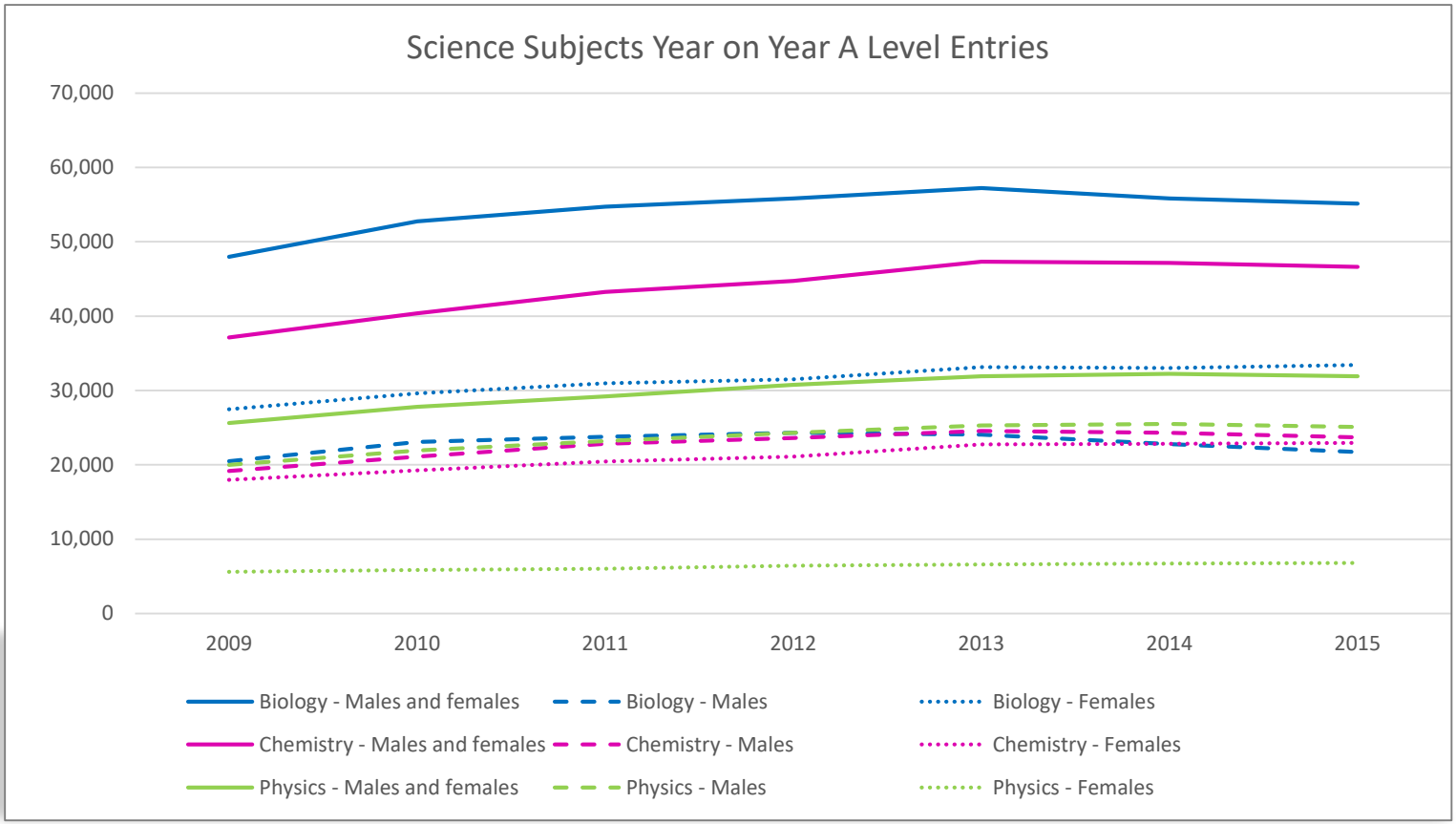
International pupil results

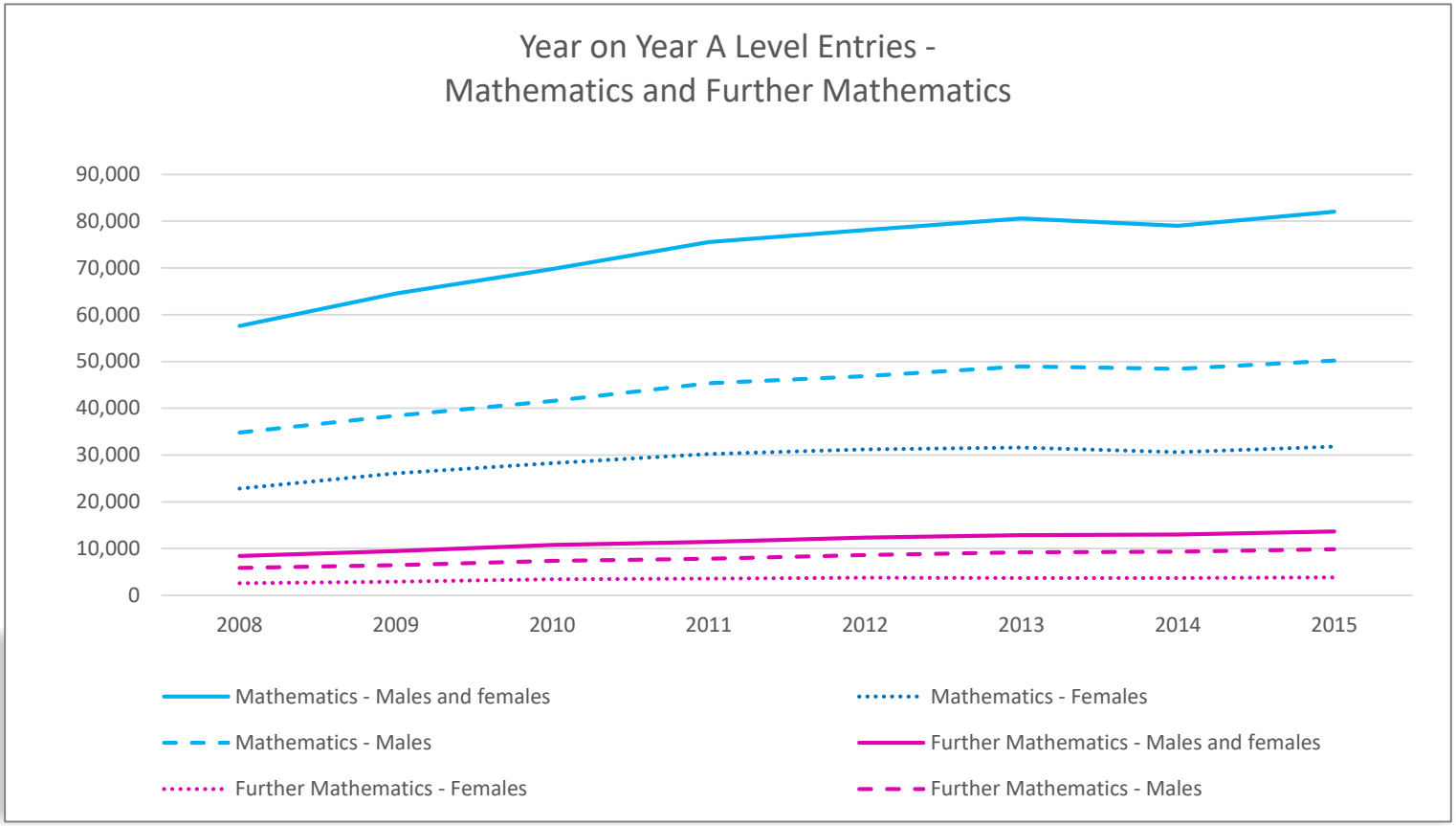


CinnabarConsultancy

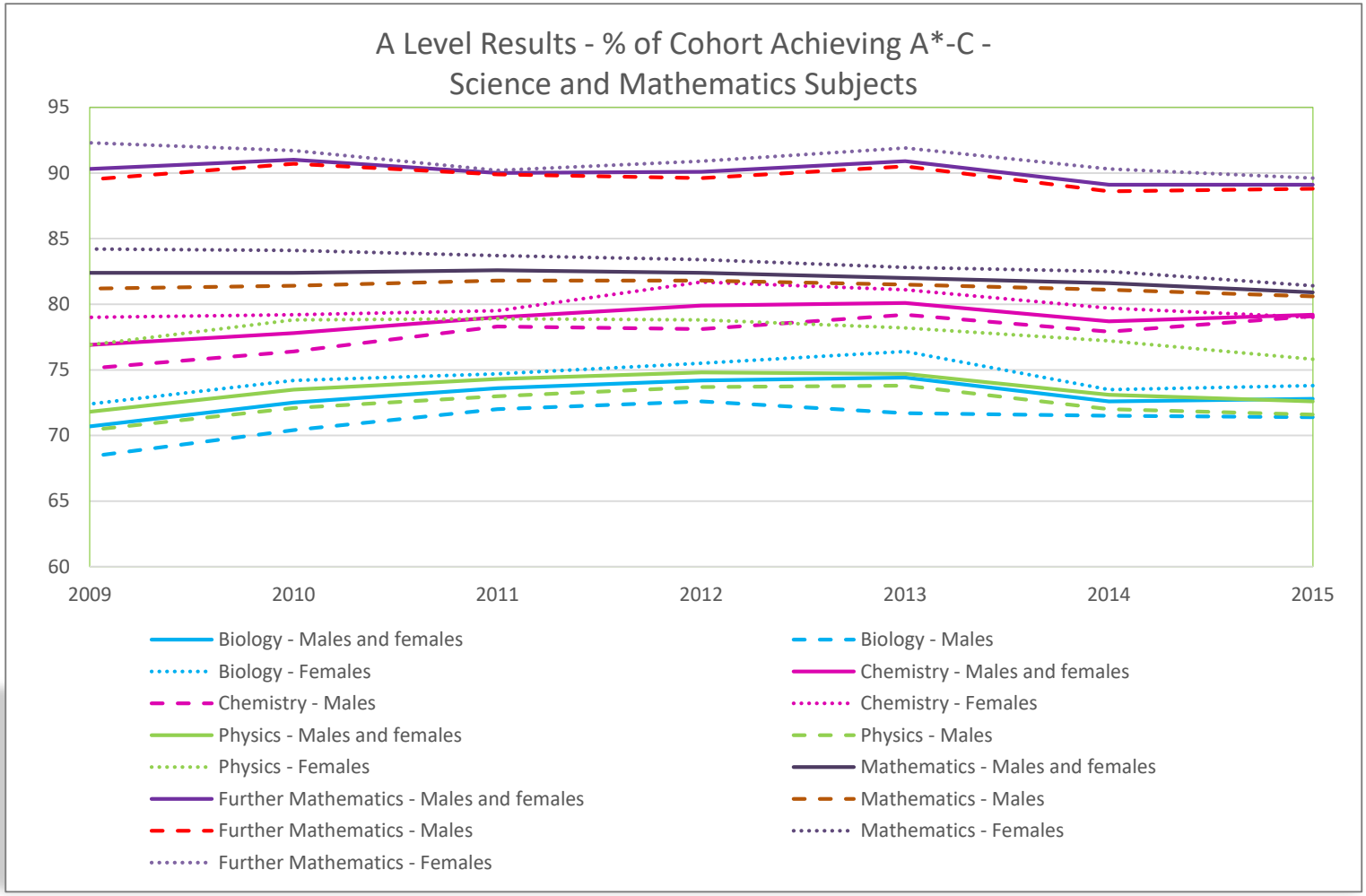
Entries to science A levels – 18-year-olds



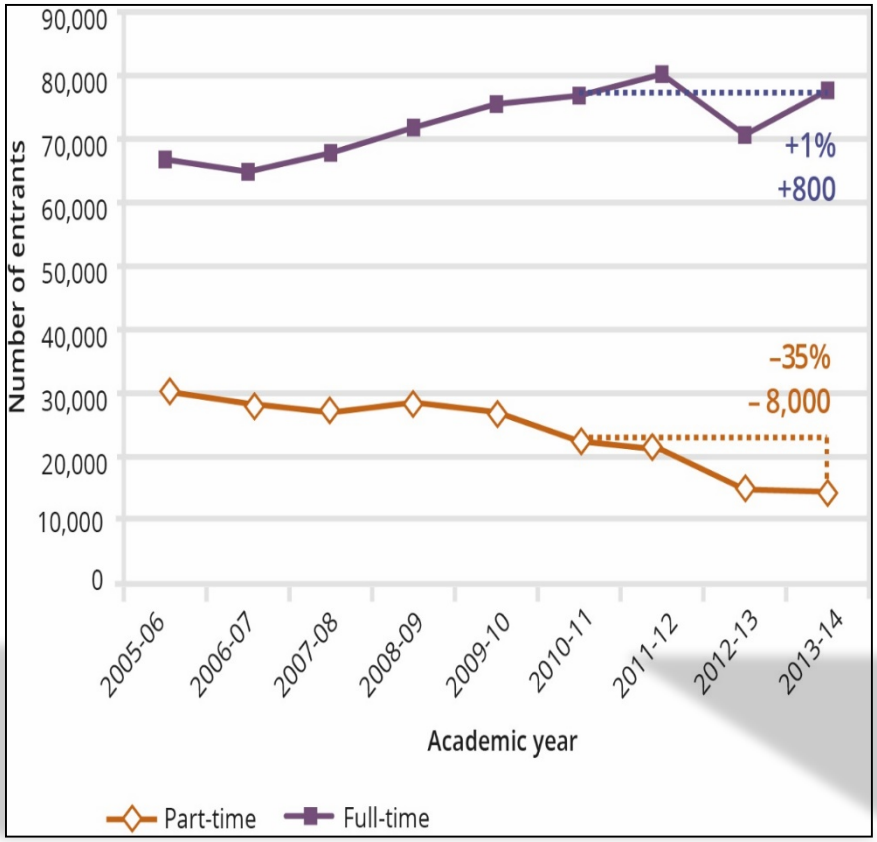
Entries to maths A levels



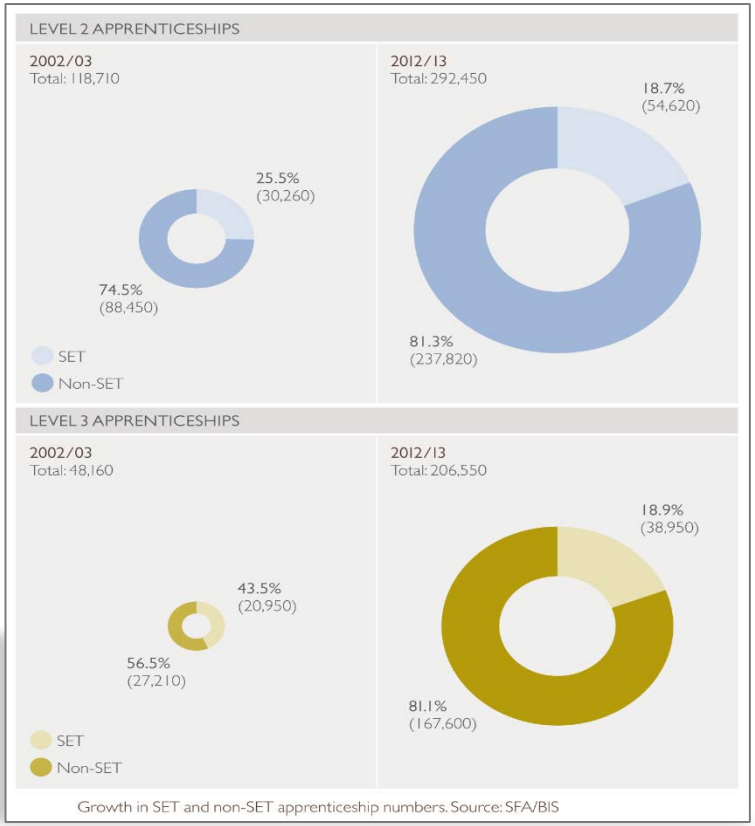
Attainment Science A levels



Progression to degrees



Progression to apprenticeships



- UK and other EU entrants to undergraduate STEM courses registered at English HEIs, 2006-06 to 2013-14:

Lesson 2

Network professional development improves teachers' subject and pedagogical knowledge, skills and confidence, resulting in better outcomes for young people.

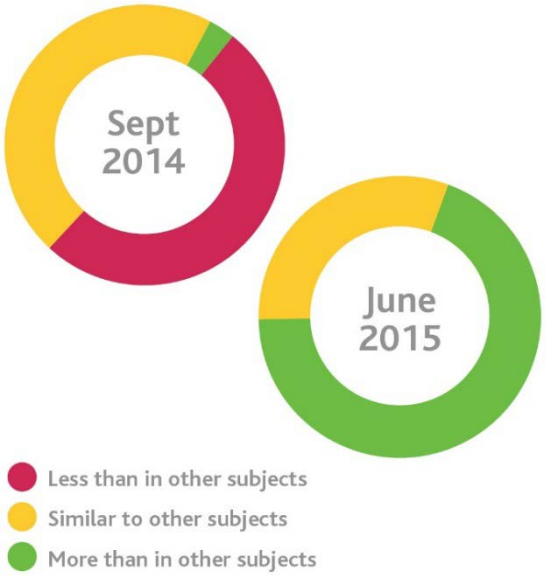
- Increased teacher confidence, subject and pedagogical knowledge leads to these outcomes for pupils:
- increased enjoyment of, and engagement in, science
- increased confidence and understanding in learning science
- development of transferable and practical skills
- increased awareness of science's role in society
- increased knowledge of science-related career opportunities improvements in progress and attainment
- increased interest in, and uptake of, science subjects and careers.

Qualitative evaluation of the National Science Learning Centre. NFER 2012

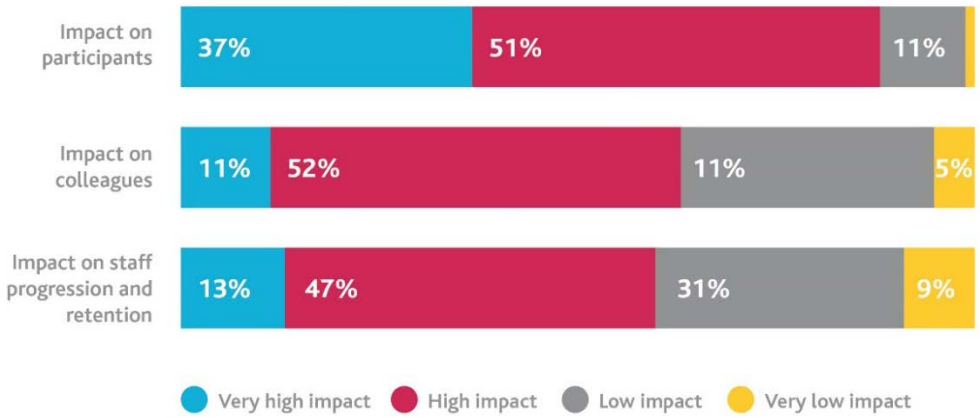
Primary teachers engaging with Network support for science specialists are clear about the impacts of the CPD with which they have engaged.

Primary Science Specialist programmes impact evaluation, 2015

Primary pupil attainment in science before and after teacher CPD



Primary schools' perceptions of the impact of CPD from the Network on staff



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Lesson 3

The National Science Learning Network develops strong leadership in science, from primary to post-16, benefiting teachers, schools and young people.

"STEM leadership CPD has resulted in impacts at a range of levels. This was most evident on CPD participants themselves as subject leaders and teachers. Colleagues and senior staff… report visible impact on the individual's leadership, quality of teaching and learning, confidence, transfer of learning to other staff, and on students' engagement, enthusiasms for and progress in STEM subjects."

Research into NSLN programmes in STEM leadership, NFER 2014.

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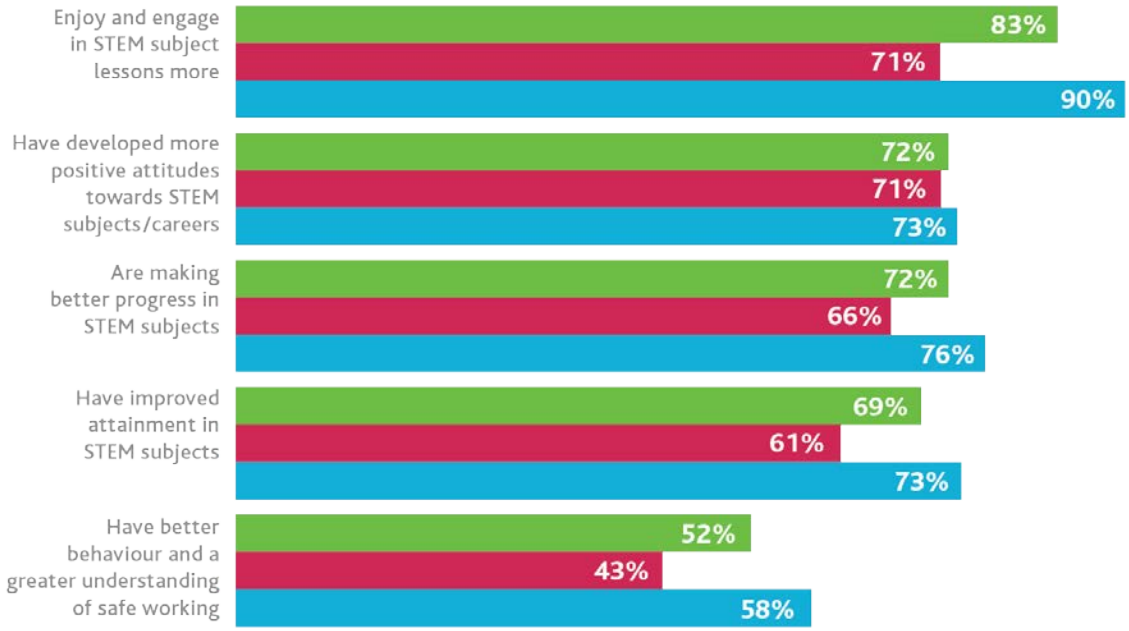
Network support for science leadership – primary and secondary

As a result of STEM leadership CPD, pupils in classes in my department/ subject area:



"It is something I would recommend to anyone who wants to get on in science"

Secondary science teacher

Overall - % strongly agree/agree

Secondary/FE- % strongly agree/agree

Primary - % strongly agree/agree

NFER Report 2014

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Lesson 4

Engagement with the Network helps schools and colleges recruit and retain excellent teachers.

"*Our science department is fully staffed….Teachers looking for their next placement see that our school demonstrates the value it places in its science teachers by investing in subject specific CPD and being part of the National Science Learning Network.*"

Vicky Neale, Headteacher, Bury St Edmunds County Upper School.

Teachers participating in Network activities showed higher likelihood of staying in teaching.

- Teachers saw significant impacts on job satisfaction, taking on new responsibilities and moving into new areas of work
- Secondary teachers also saw impacts on promotion
- Teachers reported impacts on changes in their thinking about their future career plans, even where they saw no direct impacts on career progression

Network professional development was seen to have a bigger impact on decisions to stay in teaching than other similar CPD.

The Centre for Education Inclusion and Research, 2012

Lesson 5

National Science Learning Network professional development enriches teaching, supporting young people's engagement, progression and awareness of STEM careers.

Network support led to a range of school-wide innovations including the introduction of more 'real world' contexts and examples into teaching:

"There is a lot more engagement of external support; teachers have invited individuals from business and industry to demonstrate and articulate the subject area they have been teaching."

Cluster Lead, OPM's study of ENTHUSE clusters, 2014

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STEM Insight

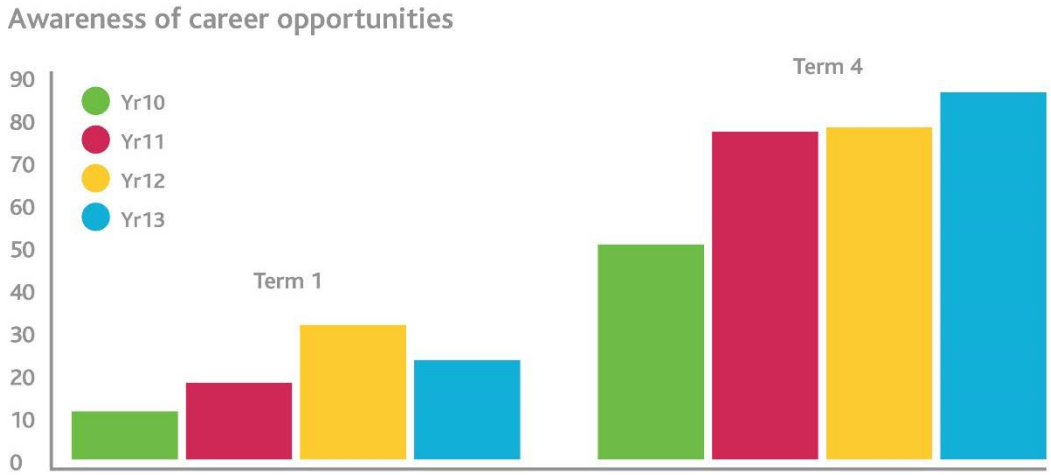
Teachers engaged with STEM Insight (TIPS) were:

- More confident in talking to students about careers in science & engineering
- More able to use appropriate practical examples in lessons
- Improved understanding of breadth & depth of STEM careers
- More confident in discussing apprenticeships & vocational routes with young people, colleagues & parents.

Evaluation of the TIPS programme, King 2015

Were students aware of STEM/Engineering opportunities such as apprenticeships?

Source: David Sandall TIPS participant 2014



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STEM Ambassadors impact report 2016

STEM Ambassadors

- inspire young people to continue to study STEM subjects and explore STEM careers
- have a positive impact on their own organisations
- enhance the quality of teaching
- develop new skills and have increased job satisfaction

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Engineering skills crisis

EngineeringUK estimates:

between 2012 and 2022…

1.82 million engineers and technicians at all levels

1.06 million engineers at level 4+

7 out of 10 replacement demand

360,000 expansion

Data from EngineeringUK 2015 annual digest

ROYAL ACADEMY OF ENGINEERING

Lessons learnt

Need for

- **A clear sustained long term government vision and commitment**
- **All political party agreement and support for STEM strategy**
- **Policy based on research and evidence-led practice**
- **Needs coherent partnership between government, employers and charitable trusts**
- **Needs to focus on multiplier effect – i.e. teacher recruitment, retraining and retention through CPD**

Enhancers for positive STEM culture

- engender societal interest in and expertise in STEM subjects
- make teaching financially and culturally appealing and attractive
- regular high quality subject-specific professional development for teachers of STEM subjects
- provide teachers with online up-to-date information and curriculum-based resources about cutting edge developments in STEM subjects
- help embed information about career pathways in curriculum materials
- provide access to experts from the world of STEM for both teachers and students;
- have a clear pathway of STEM knowledge and skills in context across the curriculum