London Schools Excellence Fund

Imperial College London
Final Report

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Evaluation Final Report

Project Oracle: Level 2
Report Submission Deadline: 30th September 2015
Report Submission: Final Report to the GLA

Project Name: Reaching Further
Lead Delivery Organisation: Imperial College London
London Schools Excellence Fund Reference: LSEF R1104
Author of the Self-Evaluation: Dr Melanie Bottrill (Imperial College London) and Emma Williams (Exscitec)
Total LSEF grant funding for project: £498,115
Total Lifetime cost of the project (inc. match funding): £516,155
Actual Project Start Date: Tuesday 13th May 2014
Actual Project End Date: Friday 30th July 2015

1. Executive Summary

Reaching Further was a series of Continuing Professional Development (CPD) programmes for teachers teaching at Key Stage (KS) 2, KS3, KS4 or KS5. It was run as a collaboration between Imperial College London, in partnership with Exscitec, and a number of 'Hub' schools distributed across London. The project was split into four discrete programmes of activity:

- Primary Science and Maths CPD workshops for KS2 teachers.
- CPD workshops and resources for science practicals for NQTs and early career teachers teaching outside their specialised subject, aimed at KS3 level.
- Development of subject specific Science and Maths activities where subject specialist teachers worked collaboratively with current researchers, aimed at KS4/KS5 teachers.
- E-mentoring and online engagement

Overall nearly 400 teachers took part in 99 workshops between May 2014 and July 2015. Nine workshops are outstanding and will be completed before December 2015. The project aimed to support teachers at various stages of their career by engaging them with practical, hands-on Science, Technology, Engineering and Mathematics (STEM) CPD to improve confidence and knowledge, and enabling them to tackle topics outside of their specialism or topics based on current scientific research. The aim was for the teachers to feel confident and able to bring relevant STEM topics into the classroom, enthusing pupils, with the longer term impact of higher aspirations and attainment.

Impact on both teachers and pupils was evaluated. Teacher impact was measured by a series of pre- and post-programme confidence and efficacy surveys, as well as pre- and post- knowledge tests linked to the topic of the CPD session. Pupil impact was analysed by comparing their attainment before and after their teachers attended CPD sessions. The project also looked at evaluating wider impact on the school system by measuring the number of interactions teachers had outside the project and their school and comparing these numbers.

The evaluation of the project demonstrated that:

- Overall teachers reported an increase in confidence following interventions across three programmes
- Subject knowledge appeared to have increased in the topics selected for CPD workshops across all teachers as a whole
- Effect on pupil attainment cannot be determined with the data available
- The project appeared to have no impact on the wider school system

The project team are reluctant to draw solid conclusions from the data, as data returns have been difficult to obtain. Despite working constructively with Hub schools throughout the project, data gathering was difficult due to pressures on schools. However, indication from qualitative data received from teachers is that the project has had a positive impact on teacher confidence and their knowledge base.

On conclusion of this project, the project team suggest the following recommendations for similar projects:

- Plan for a longer delivery schedule to effectively manage changes to timetabling, industrial action and teacher churn.
- Consider competing initiatives available to schools because this will impact outputs significantly, as this project found that the market was oversaturated with LSEF initiatives, which effected recruitment of teachers.
- Consider location of the CPD venues carefully because this will, in part, determine the attendance at workshops.
- Consider students participating in CPD workshops alongside teachers. This proved to be effective within the Primary programme.
- Consider how data returns will be measured in collaboration with project partners to ensure efficient use of resources.
- When working in a hub model, a single point of contact is invaluable both in the Hubs, and within the coordinating organisation.

2. Project Description

The establishment of the Wohl Reach Out Lab (ROL) at Imperial College and the subsequent submission of the Reaching Further Programme to the London Schools Excellence Fund (LSEF) was predicated on evidence that practical science is key in inspiring and encouraging an interest in science in school students and that there was deficient provision partly due to the confidence,

competence and training of teachers. In 2001, a Select Committee recommended "*CPD should be specifically targeted at the problem of declining practical work*"[1]

The Reaching Further Programme was designed to support and develop practical Science and Maths activities alongside teachers, using specific schools as 'Hub' schools. The Hub schools linked the programme, and by extension the ROL and Imperial College London, with a network of schools and teachers across London. The programme aimed to support the Science and Maths curriculum through the development of CPD workshops and classroom activities. Some were based on current scientific research, and other focused on needs identified by teachers within the Hub schools. These workshops were delivered within the Hub schools and at Imperial College London, with the Hub schools using their school networks to promote engagement to their local primary and secondary schools. In addition, a programme of e-mentoring between early career and established teachers aimed to facilitate professional links between teaching practitioners, as well as between researchers and specialist teachers delivering STEM curriculum content. The overall programme delivered STEM subject support at KS2, KS3, KS4 and KS5.

The overall project was split into four distinct programmes of activity:
- Primary Science and Maths CPD that used established ROL Primary activities.
- Support and resource material for science practical's aimed at NQTs and early career teachers teaching outside their specialised subject.
- Development of subject specific Science and Maths activities where subject specialist teachers worked collaboratively with current researchers.
- E-mentoring to support the interaction of all teachers with their peers and researchers, with the anticipated benefit of aiding information gathering.

The programme targeted teachers in London who identified with the following profiles:
- KS2 teachers without a Science background.
- KS3 / KS4 NQTs in Maths, Science or those teaching out of specialism.
- KS4 / KS5 subject specialist teachers in Maths or Science who were seeking CPD to enhance curriculum content with current research topics.

Approximately 50% of the LSEF funding within the Imperial College London project was for a Primary Professional Development Teacher Training Programme. Teachers and five of their pupils in Y5 or Y6 attended four events, each focused on a different topic in STEM. The activities were:
- Dynamic Maths which focused on linking geometry to engineering applications around the world.
- Robotics which focused on elements of programming.
- CSI which aimed to introduce concepts of scientific investigation using fingerprint analysis, blood detection and DNA isolation.
- Astronomy which focused on understanding the solar system and galaxies.

This successful professional development model for primary teachers trains them with hands-on activity alongside a small number of their students who subsequently act as mentors in support of the teacher's delivery to larger class groups. ONS data within the Joseph Rowntree report on poverty and educational attainment points to a downward trend in performance including STEM subjects for disadvantaged and underrepresented groups of students at the start of KS3 and beyond.[2] This programme was proposed as a potential mechanism for stimulating more STEM activity within Primary schools, aiming to impact STEM disengagement of students from quintiles 4 and 5 across the transition into secondary education.

After attending the four sessions, teachers were provided with supporting materials and the necessary equipment for them to use the activities within their schools. The aim was that primary teachers, who were confident running these activities, could disseminate the training onto other teaching colleagues, and thus propagate the knowledge within the school. Benefitting students could then experience the practical application of science at a younger age and view STEM subjects as interesting and fun, encouraging continued study of STEM subjects at secondary school and beyond.

Programme two was aimed towards secondary teachers who teach a STEM subject outside of their specialist subject area and, in particular, the programme aimed to support NQTs and early career

teachers. Links were established between subject specialists in Hub schools and trained STEM educators, resulting in core content enrichment activities being introduced to enhance the confidence of non-subject specialist teachers. Subject specialist content was also introduced to teachers, with an option for curriculum-linked activities to be developed to ensure that the teacher felt confident in executing these sessions in school.

Programme three was designed to connect scientific researchers with subject specialist teachers in order to introduce current research "hot topics" into the classroom. The aim of this was to enable teachers to support higher-level learners and expand modules of the KS5 syllabus. Working alongside Imperial College London researchers, subject specialist teachers developed hands-on educational activities linking research topics to the current curriculum.

The programme was delivered by Imperial College London in partnership with Exscitec. The five Hub schools were initially planned to be:
- Bacon's College.
- Burntwood Academy.
- Watford Grammar School for Boys.
- William Perkin Academy.
- Harris Federation of Academies.

The aim was that the five schools would provide access to a network of schools across London, specifically covering the North, South, East and West of the capital with hub schools located in Enfield, Wandsworth, Croydon, Southwark, Ealing and Watford in West London. However, as the programme progressed Watford Grammar School for Boys was found to be inaccessible for after work CPD sessions, and the decision was made to cancel planned sessions. Imperial College London then acted as an alternative venue for the secondary programmes and Enfield local authority coordinated the primary programme. The breadth of the spread of participants across London is demonstrated in Figure 1.1 and Figure 1.2.
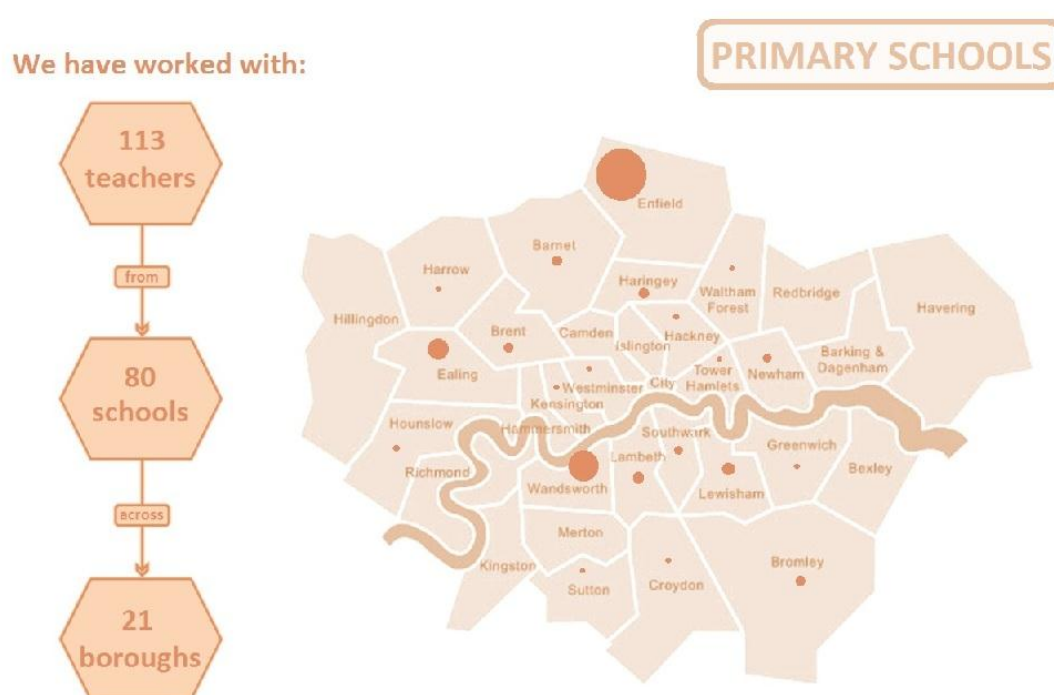

Figure 1.1 – The number of Primary teachers and schools engaged across London.
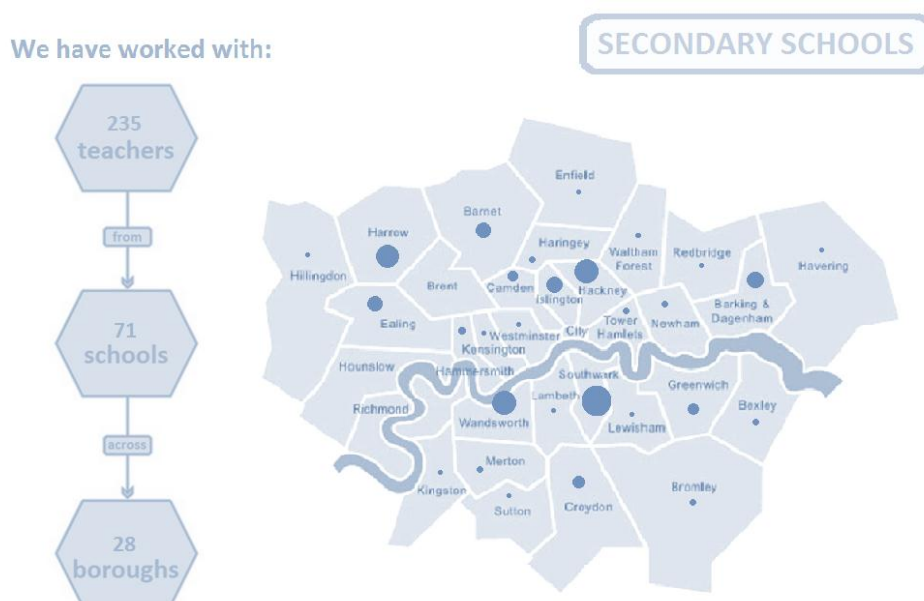
Figure 1.2 – The number of Secondary teachers and schools engaged across London.

2.1 Supporting Transition to the New National Curriculum

The Reaching Further project supports transition to the new national curriculum. Some of the Hub schools identified key areas that they wished to focus on - a number of sessions which were run across the hubs focused on developing resources for core practical's in KS5, and supporting problem topics within Science at KS4 and KS5. KS2 Primary activities and resources provide curriculum links to Thinking Scientifically, Life Processes and Living Things, Physical Processes, the Earth and Beyond, and KS2/3 links to Geometry (properties of shape), Symmetry of Regular Polygons and Polyhedral. The KS2 Primary robotics activities provide links to the KS2 Computing curriculum, in particular simple programming with cross reference to ICT.

2.2 Resources Generated

Resources are available for download at the present time for teachers involved with the programme (www.reachingfurther.org), will be available after the project end date on the Imperial College London website (www.imperial.ac.uk/schools), and shared on the LondonEd website in due course.

3. Theory of Change and Evaluation Methodology

The Reaching Further Theory of Change is attached at the end of this report in Appendix 1, and the Evaluation Framework as Appendix 2. There have been no amendments to the programme that required an update to the Theory of Change. The evaluation methodology has remained mostly similar to the evaluation framework plan that was finalised in September 2014, although some aspects of the framework have proven more difficult to implement than others.

3.1 Project Outcomes

Key to outcomes

Blue	Teacher Outcomes
Green	Student Outcomes
Red	Wider System Outcomes

The grey shading in Table 1a, 1b and 1c indicates where an outcome is not relevant. It was either not an outcome initially, or removed during progression of the project.

Table 1a - Primary Programme

Description	Original Target Outcomes	Revised Target Outcomes	Reason for change
Increased subject knowledge and greater awareness of subject specific teaching methods in Science and Maths	Increased teacher scores in subject knowledge tests		
Increased teacher confidence	Increased teacher scores in confidence survey		
Delivery of higher quality teaching including subject focused teaching methods	Improved teaching performance in observed lessons		Schools very resistant to this measure to the extent that this could not be undertaken
Use of better subject specific resources	Development of better subject specific resources		Deemed to be no longer necessary in discussion with Project Oracle and impossible to measure quantitatively
Increased educational attainment and progress			
Increased take up of specific subjects			
Heightened long term ambition			
Teachers / Schools involved in intervention making greater use of networks, other schools and colleagues to improve subject knowledge and teaching practice	Increased attendance at network meetings, conferences Increased participation in 'online' subject for practice networks Increased numbers of schools opting in to participate in networks	Increased attendance at network meetings, conferences	The uptake of teachers using the project portal was so low that it was not measurable. The project team therefore could not gather and analyse network data

Table 1b - Non-Specialists Programme

Description	Original Target Outcomes	Revised Target Outcomes	Reason for change
Increased subject knowledge and greater awareness of subject specific teaching methods in Science and Maths	Increased teacher scores in subject knowledge tests		
Increased teacher confidence	Increased teacher scores in confidence survey		
Delivery of higher quality teaching including subject focused & teaching methods	Improved teaching performance in observed lessons		Schools very resistant to this measure – to the extent that this could not be undertaken
Use of better subject specific resources	Development of better subject specific resources		Deemed to be no longer necessary in discussion with Project Oracle and impossible to measure quantitatively
Increased educational attainment and progress	Increased attainment compared against comparison group		

Increased take up of specific subjects	Increased numbers of pupils taking up STEM subjects at GCSE, A-level and H/FE against comparison group		Delivery timelines too short to enable measurement of this with pupils
Heightened long term ambition	Likely subject choices in next school level for intervention group and comparison group		Delivery timelines too short to enable measurement of this with pupils for this section of the project
Teachers / Schools involved in intervention making greater use of networks, other schools and colleagues to improve subject knowledge and teaching practice	Increased attendance at network meetings, conferences Increased participation in 'online' subject for a/practice networks Increased numbers of schools opting in to participate in networks	Increased attendance at network meetings, conferences	The uptake of teachers using the project portal was so low that it was not measurable. The project team therefore could not gather and analyse network data

Table 1c - Specialists Programme

Description	Original Target Outcomes	Revised Target Outcomes	Reason for change
Increased subject knowledge and greater awareness of subject specific teaching methods in Science and Maths		Increased teacher scores in subject knowledge tests	Implemented this as an additional measure
Increased teacher confidence	Increased teacher scores in confidence survey		
Delivery of higher quality teaching including subject focused & teaching methods			
Use of better subject specific resources	Development of better subject specific resources		Deemed to be no longer necessary in discussion with Project Oracle
Increased educational attainment and progress	Increased attainment compared against comparison group		
Increased take up of specific subjects	Increased numbers of pupils taking up STEM subjects at GCSE, A-level and H/FE against comparison group		Delivery timelines too short to enable measurement of this with pupils
Heightened long term ambition	Likely subject choices in next school level for intervention group and comparison group		
Teachers / Schools involved in intervention making greater use of networks, other schools and colleagues to improve subject knowledge and teaching practice	Increased attendance at network meetings, conferences Increased participation in 'online' subject for a/practice networks	Increased attendance at network meetings, conferences	The uptake of teachers using the project portal was so low that it was not measurable. The project team therefore could not gather and analyse

	Increased numbers of schools opting in to participate in networks		network data

3.2 – 3.4 Alterations to Evaluation Framework and Evaluation Methodology

There were no changes to the project activities after the validation of the Evaluation Framework; however there were revisions to the outcomes for each programme, as outlined in Tables 1a – c.

There were no changes to the curriculum subjects or the key stage.

The methodology remained largely the same, with the same tools utilised, especially with regards to the teacher outcomes – surveys and knowledge tests. Available data for the teacher outcomes was more limited than expected so a sampled approach was abandoned and all obtained data was analysed. For the pupil outcomes, attainment data was obtained from the Hub schools but not all schools provided complete and comparable data. Methodology remained the same for the outcomes that were evaluated but fewer outcomes were analysed overall due to lack of available data.

4. Evaluation Methodological Limitations

National Curriculum changes have impacted significantly on the willingness and ability of Primary schools to provide level data linked to the SATs information now redundant in terms of Primary school pedagogy. This is especially true in relation to levels in Science. Moreover, lead partners did not consider it either productive or appropriate to look back at such information since the landscape for science has changed so much within Primary schools and schools indicated they were unhappy "predicting" any data. This resulted in schools attainment data not being provided for Primary pupils.

Schools and teachers were also resistant to observation sessions, particularly at Primary level. The use of OFSTED-like observations at Primary level was considered inappropriate and Hub schools considered it potentially damaging to their feeder Primary/Secondary school relationships. Their opinion was that the self-efficacy survey was more effective and a softer way of obtaining teacher opinion on performance. This has meant that the number of outcomes the project aimed to evaluate was reduced to self-confidence and knowledge testing – both of which were collected reasonably effectively, if in smaller sample sizes than hoped for due to lack of data return. Feedback from the Hub schools indicated that there was significant resistance to undertaking the tests and surveys in some cases.

There have been problems identifying reliable control pupil groups for the Secondary programme. The team believes that where possible this has been resolved. However, this was only towards the end of the programme, which may impact validity of the data obtained. For instance, it was not possible to select control groups where individual characteristics were compared and matched.

Time frames for delivery have impacted on the data that could be obtained in all aspects of the programme. Initially, it was anticipated that teachers would be surveyed with both their self-stated confidence and subject knowledge before any CPD, at the end of CPD and then again after 6 or 12 months. Logistically, due to the late start of the project, this has proven to be very difficult and, for most teachers, the latter data point would not have been available until 2015-2016 academic year. As a result, although long-term impact was hoped to have been shown it has not been feasible to collect data on this. In addition, data gathered post intervention has varied timescales. Some data was immediately collected, and other data had to be collected at a later date. There is therefore some significant difficulty in validating the impact on the teachers.

Gathering pupil data from the Secondary schools has also been problematic. Whilst pre-intervention data was obtained, only partial post-intervention data was made available. Data was either partial, in that not all fields were available, or simply not returned. In addition, with the limited time-frame of delivery, there is little confidence that any impact observed in the analysis is a consequence of the teacher interventions and not due to other factors.

4.2 Continuation of the Project post-funding

At the time of reporting, the project is unlikely to continue in its current format, predominately due to the levels of feedback required. Imperial College London remains committed to continuous engagement with teachers and will continue to engage with the Hub schools and in teacher CPD. The College is currently investigating the variety of ways in which this could happen and has committed to funding two staff posts (2.0FTE) for schools coordination. Parts of each role will be devoted to working on teacher CPD projects and other ways of engaging with the teaching community.
Evaluation will continue to be an integral part of this, and successes from this project, especially in the areas of evaluation of teacher confidence, will be maintained.

5. Project Costs and Funding

Table 2 and Table 3 outline the project income and expenditure, compared prior to the start of the programme and at the date of reporting.

Table 2 - Project Income

	Original[1] Budget	Additional Funding	Revised Budget [Original + any Additional Funding]	Actual Spend	Variance [Revised budget – Actual]
Total LSEF Funding	£498,155		£498,155	£471,323	£26,832
Other Public Funding					
Other Private Funding	£73,760		£73,760	£73,760	
In-kind support (e.g. by schools)	£95,300	£17,288	£112,588	£112,588	
Total Project Funding	**£667,215**	**£17,288**	**£684,503**	**£657,671**	**-£26,832**

The in-kind support, totalling £112,588, comes from a variety of sources within the College. The bulk of funding is £79,900, which is the total time commitment to the project from salaried staff. This includes development of content (researcher time), event planning, communications and financial oversight. £4,000 is from in-kind venue hire, covered by the Outreach annual space charges within the College, and £3,288 is from costs associated with the additional support required for evaluation and data cleansing. The remaining £14,000 is consultancy fees required for oversight of the project and funded in-kind from the College.

The private funding stipulated in Table 2 was seed funding from the BG Group, who financially supported the initial Primary programme upon which the current Reaching Further Primary programme was based. The College, with £11,400 of in-kind funds, also supported this seed project. Currently the project is underspent. The project team has applied for, and been granted, a delivery extension to use this small underspend, which will be spent before December 2015.

Table 3 - Project Expenditure

	Original Budget	Additional Funding	Revised Budget [Original + any Additional Funding]	Actual Spend	Variance Revised budget – Actual]
Direct Staff Costs (salaries/on costs)	£182,075	£0	£182,075	£192,983	+£10,908
Direct delivery costs: consultants	£0	£14,000	£14,000	£14,000	£0

Management and Administration Costs	£53,450	£0	£53,450	£48,950	-£4,500
Training Costs	£0	£0	£0	£0	£0
Participant Costs (e.g. Expenses for travelling to venues, etc.)	£105,750	£0	£105,750	£69,500	-£36,250
Publicity and Marketing Costs	£3,750	£0	£3,750	£1,250	-£2,500
Teacher Supply / Cover Costs	£0	£0	£0	£0	£0
Evaluation Costs	£9,750	£3,288	£13,038	£16,326	+£3,288
Venue Hire Costs	£44,000	£0	£44,000	£46,450	+£2,450
Catering Costs	£450	£0	£450	£1,870	+£1,420
Consumable Costs	£3,500	£0	£3,500	£5,000	+£1,500
Equipment Costs	£190,730	£0	£190,730	£187,582	-£3,148
Total Costs	**£593,455**	**£17,288**	**£610,743**	**£583,911**	**-£26,832**

5.2 Budget Summary

Overall, the final costing is similar to that budgeted at the start of the project. The only major budget changes that have occurred during the operation of the activities come predominantly from the participant costs and for the most part this is due to underspend in the project. The major overspend has come in direct staff costs, which is a consequence of the Hub schools wishing the project team to undertake delivery of the CPD sessions. These were initially budgeted for schools to undertake themselves, further explanation can be found in section 11. Other deviations are relatively modest when compared to overall budget profiles. The next most significant deviation comes from expenditure for evaluation – this required additional funding, contributed in-kind by the College and resulted in overspend. This is due to additional staff costs required to bring in data entry staff to ensure the reporting was in place for final deadlines.

6. Project Outputs

Table 4 – Outputs

Description	Original Target Outputs	Revised Target Outputs *[Original + any Additional Funding/GLA agreed reduction]*	Actual Outputs	**Variance [Revised Target - Actual]**
No. of schools	250	250	151	**-99**
No. of teachers	1100	1100	392	**-708**
No. of KS2 teachers	100	100	113	**+13**
No. of KS3 / NQT teachers	500	500	167	**-333**
No. of KS4/5 teachers	500	500	112	**-388**
No. of pupils*	33,000	33,000	11,760	**-21,240**

* Number of pupil outputs is calculated by assuming one teacher benefits 30 pupils

Whilst the actual outputs at the time of reporting are lower than the original targets, they show a rapid increase from outputs in the October 2014 interim report. This is a consequence of the Hub schools committing to dates during the spring and summer terms of 2015. Delivery of the CPD is continuing, and outputs are expected to rise in the autumn term, towards conclusion of delivery in December 2015. Another nine CPD events are planned, with approximately 110 teachers expected to attend, although these teachers may not be unique. It is also worth noting that teachers may have attended more than one CPD session and so the actual numbers of teacher interventions are significantly higher than the outputs.

7. Key Beneficiary Data

7.1 Teacher Sub-Groups

Teachers benefitting from the programme are counted as those who attended a CPD session, either in the Primary programme or within either of the Secondary programmes. Those who engaged on the portal but did not attend a formal CPD session in person are not included in the data below.
Teachers were surveyed between May 2014 and July 2015 and asked to state the key stage at which they teach, and their experience. Very few teachers responded to this survey (77 of 392 participants) so numbers are unlikely to be representative of the whole cohort. Teachers were not asked to report on 2-3 years so this data is unavailable.

Table 5 – Teachers benefitting from the programme

	No. teachers	% NQTs (in their 1st year of teaching when they became involved)	% Teaching 2 – 3 yrs (in their 2nd and 3rd years of teaching when they became involved)	% Teaching 4 yrs + (teaching over 4 years when they became involved)	% Primary (KS1 & 2)	% Secondary (KS3 - 5)
Project Total	392	3.6%	N/A	16.1%	36.57%	63.43%

It is difficult to draw analysis from the teacher sub-groups with only a 19% response rate to the survey. It is interesting to note, however, that the project aimed to have 9% of the teachers from a primary level, and the reported level is much higher. This may be due to the primary teachers feeling more committed to the project overall because of the nature of their more continual engagement (signing up for four CPD sessions and receiving materials for use in school) than secondary school teachers.

7.2 Pupil Sub-Groups

The definitions of 'pupils who benefit' is those who were taught by teachers who have received CPD within the Hub schools. The number of total beneficiaries is significantly higher than those reported in Table 6. This is a consequence of the data only being available for selected students in the Hub Schools because teachers involved in one off CPD sessions were reluctant to provide data on their pupils.
The data from School 1 was obtained in February 2015, School 2 in March 2015 and School 3 in September 2015.

Table 6 – Pupil Sub-Groups benefitting from the programme

	No. pupils	% LAC	% FSM	% FSM last 6 yrs	% EAL	% SEN
Project Total	7930	0.45%	43.08%	24.18%	16.28%	12.13%
School 1	1258	N/A	43.08%*	62.5%±	41.4%±	15.18%*
School 2	6645	0.45%*	27.0%±	24.18%*	16.28%*	11.56%*
School 3	53	1.88%*	9.43%*	18.0%±	15.09%*	22.64%*

* Calculated from data provided by schools
± Gathered in 2015 from DfE Schools performance tables

Table 7 – Pupil Sub-Groups benefitting from the programme*

	No. Male pupils	No. Female pupils	% Lower attaining	% Middle attaining	% Higher attaining
Project Total	3919	4037	11.9%	38.1%	43.6%
School 1	673	585	11.5%	35.5%	48.2%
School 2	3207	3438	12.3%	45.5%	30.6%
School 3	39	14	N/A	33.3%	51.9%

* Calculated from data provided by schools

Table 8 – Pupil Sub-Groups benefitting from the programme

	% Asian Indian	% Asian Pakistani	% Asian Bangladeshi	% Asian Any Other background	% Black Caribbean	% Black African	% Black Any Other Background	% Mixed White & Black Caribbean	% Mixed White & Black African	% Mixed White & Asian	% Mixed Any Other Background	% Chinese	% Any other ethnic group
Project Total	2.1	2.1	2.2	3.8	11.3	6.3	6.7	3.3	0.9	0.7	4.9	0.5	13.2
School 1[*]	0.5	1.0	1.5	2.7	7.1	25.4	10.2	1.8	1.4	0.3	3.9	1.9	8.0
School 2[*]	2.4	2.3	2.3	4.0	12.2	11.2	6.1	3.6	0.9	0.7	5.0	0.3	5.4
*School 3**	9.4	0	0	7.5	9.4	6.5	1.9	3.8	3.8	1.9	7.5	0	14.3

	% White British	% White Irish	% White Traveller of Irish heritage	% White Gypsy/Roma	% White Any Other Background
Project Total	32.9	0.2	0.1	0.1	8.7
School 1[*]	26.6	0.3	0	0	7.4
School 2[*]	33.8	0.2	0.2	0.1	9.0
School 3[*]	26.4	1.9	0	0	5.7

* Calculated from data provided by schools

7.2.1 Beneficiary Summary

The funders requested these data sets, and unfortunately not all schools provided data on their student populations, limiting conclusions on how representative these samples were. For those that did, there are similarities between the school profiles and that of the boroughs, but also areas of clear differences. The data was provided by schools in 2014 and is compared to data taken from the London Data Store at the same time.[3]

School 1 is a mixed comprehensive in the London Borough of Southwark. The school participants in the programme are generally representative of the borough in terms of pupil ethnicity, with the major ethnic groups being white British (26.6%) and black African (25.4%) – demonstrated in Figure 7.1. This compares to the borough secondary school population of 22% and 29% respectively. This is not comparable to London on the whole, which has overall more white British secondary school students (31%), and less black African students (13%), nor comparable to the data from inner London Boroughs – 30.2% and 17.8% respectively.
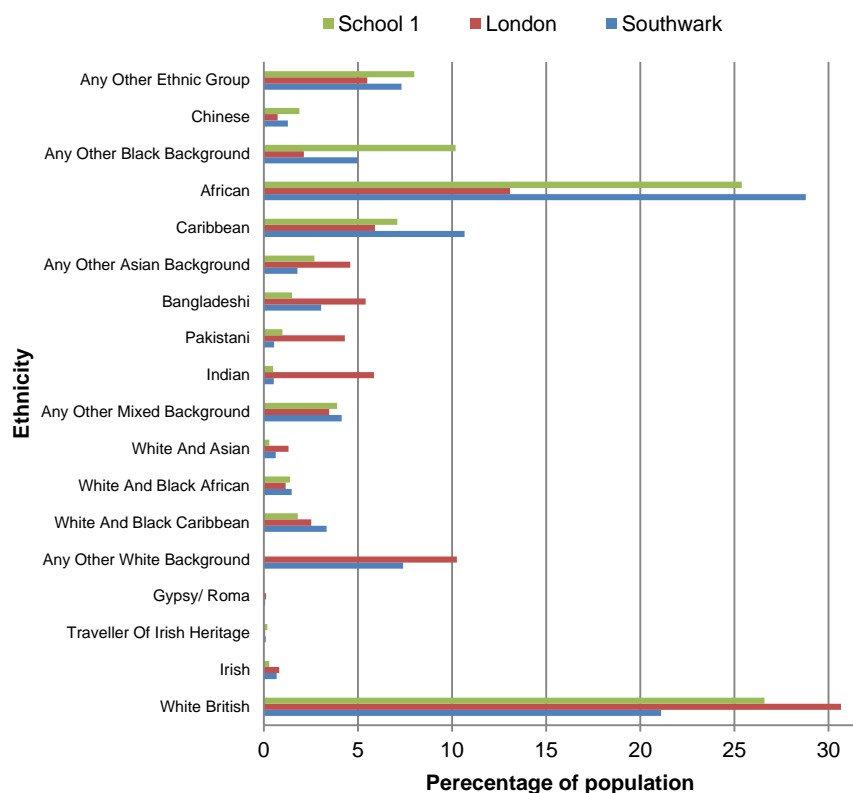
Figure 7.1 – Comparison of Ethnic Groups between School 1, its borough and London.

In terms of free school meals (FSM), School 1 is not representative of either the borough or London, having a higher than average student population designated as FSM – demonstrated in Figure 7.2. However, in comparison, it has a lower population of looked after children (0.45%) than the borough (0.91%) and London overall (0.64%).
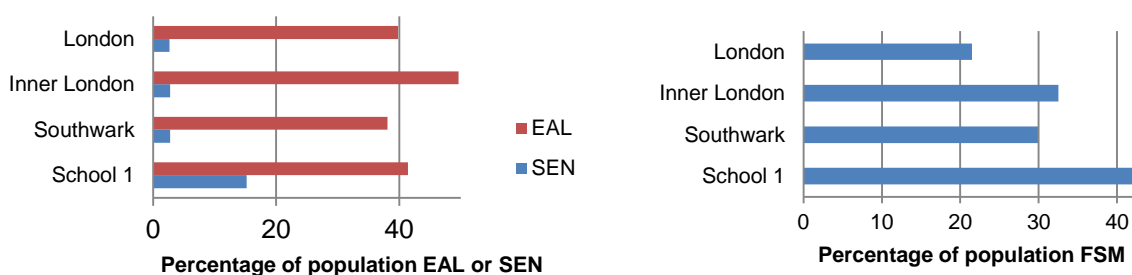

Figure 7.2 – Comparison of FSM, EAL and SEN Levels in School 1, its borough and London.

In terms of students with English as an addition language (EAL), the school is typical of the borough in which it resides, and of London. The school appears to have a significantly higher proportion of students with some level of special educational needs (SEN) than London or the borough generally as per Figure 7.2. The data is not easily comparable due to data on London and its boroughs only being available for statemented SEN pupils but data from the school did not specify the SEN type and is expected to be more than just statemented pupils.

School 2 is made up of several academies spread across London. The majority of those schools where data was provided were situated in the London Borough of Croydon. The three largest ethnic groups of the participants are reasonably representative of the borough - white British (34.1%), black African (11.2%) and black Caribbean (12.1%), as seen in Figure 7.3. This is comparable to 34.1%, 13.9% and 11.9% populations respectively for the secondary students in the entire borough. Similarly

to School 1, this is not overly comparable to London as a whole, where a much lower 5.9% of the student population are of Caribbean ethnicity.
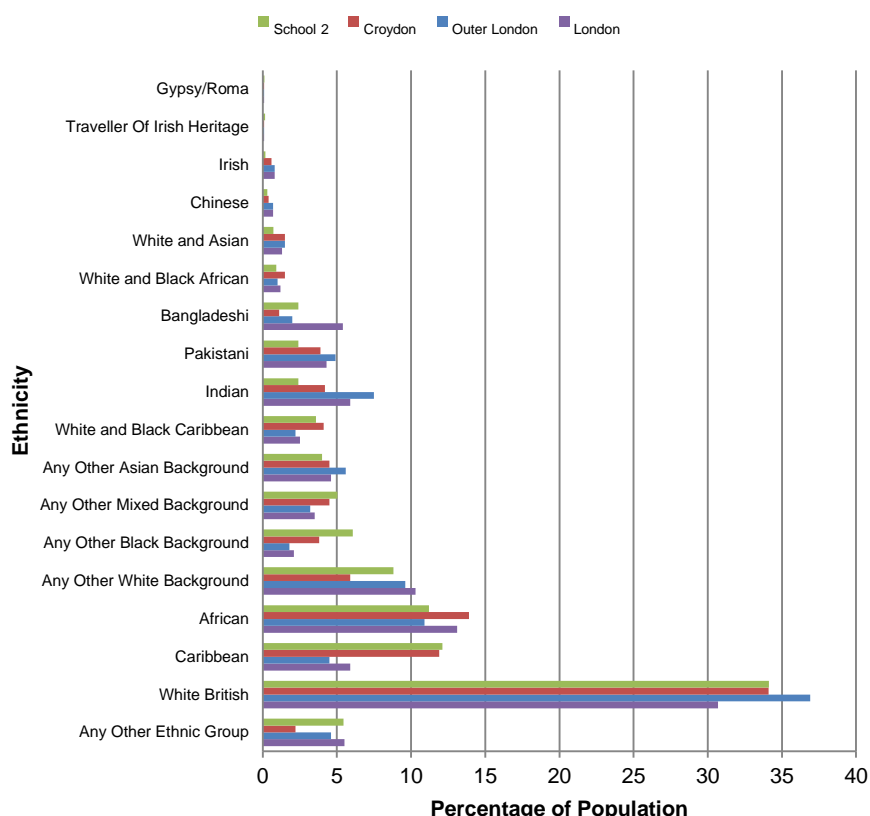

Figure 7.3 - Comparison of Ethnic Groups between School 2, its borough and London.

The percentage of students at School 2 who receive free school meals (27.0%) is higher than its borough and the London averages (18.1% and 21.5% respectively), demonstrated in Figure 7.4. However, it is worth noting the FSM data for School 2 was gathered more recently than 2014.[4] The population of looked after children (LAC) is similar to what might be expected. School 2 has 0.46% of its students classified as LAC whereas London has 0.54% LAC, but Croydon has a higher proportion at 0.86%.
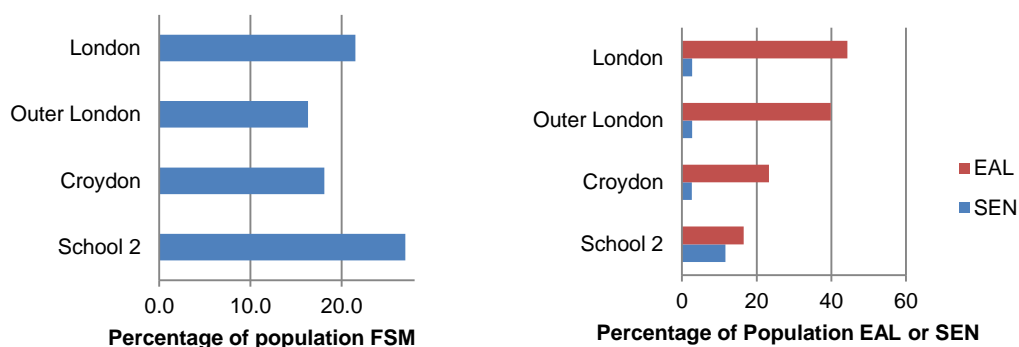

Figure 7.4 – Comparison of FSM, EAL and SEN Levels in School 2, its borough and London.

In terms of EAL, the school (16.5%) has a lower percentage of students than you would expect for the borough (23.3%) and London as a whole (44.3%). Figure 7.4 also shows the school has a higher than average percentage of SEN students (11.6%) when compared to Croydon and London. Again, this number is not a reliable comparison due to the school data not specifying SEN type.

School 3 is a mixed academy in the London Borough of Ealing. The data received from the school was for very small sample of students and therefore the ethnicities are not representative of the borough or London. There is a larger population of white British students (26.4%) than the average for the borough (18.4%). The second largest ethnic group of the sample of students from School 3 is Indian (9.4%), shown in Figure 7.5. This is higher than the London population percentage (5.9%) but lower than the Ealing population, where 13.4% of secondary aged students are of Indian ethnicity.
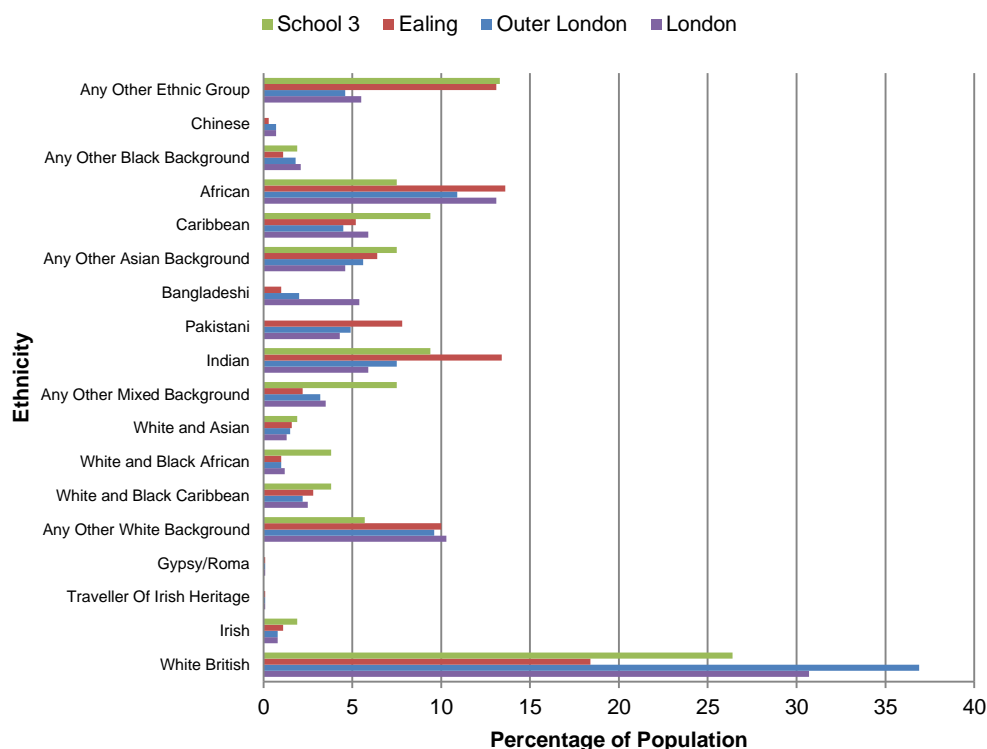

Figure 7.5 - Comparison of Ethnic Groups between School 3, its borough and London.

The percentage of students eligible for free school meals at School 3 (9.4%) is lower than both the borough (22.6%) and London averages, demonstrated in Figure 7.6. In terms of LAC, School 3 is not representative of the borough or London, with 1.9% of students at School 3 being a looked after child compared to a borough average of 0.49%.
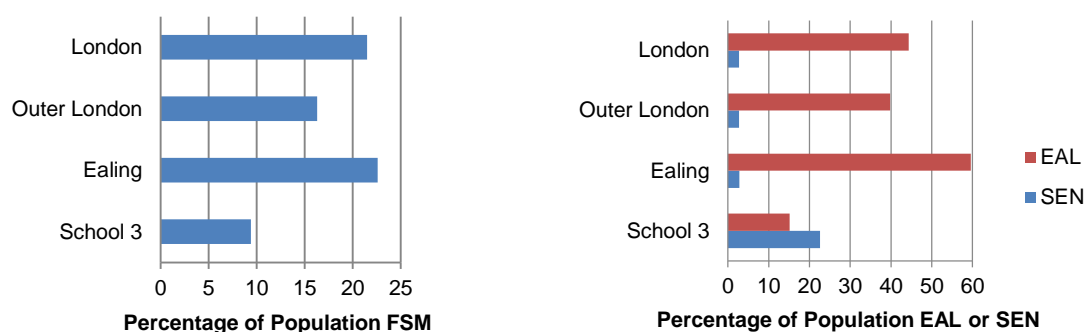

Figure 7.6 - Comparison of FSM, EAL and SEN Levels in School 2, its borough and London.

Both the EAL and SEN percentages for School 3 vary from the expected borough figures. School 3 has significantly less EAL students than the borough average of 59.6%. As with both of the other schools, the percentage of SEN students is much higher at 22.6% compared to London's 2.7%. For School 3, the data set is too small to be reliable so any conclusions drawn should be treated with caution.

8. Project Impact

8.1 Teacher Outcomes

Teacher Outcomes: teachers benefitting from the project

Table 9a - Primary Programme teacher intervention started: May 2014

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
Increased subject knowledge and greater awareness of subject specific teaching methods in Science and Maths	Electronic or paper pre- and post-CPD subject tests	113 attendees invited to respond to pre- and post- tests. 113 pre-event responses 11 post-event responses	*Mean score of total number of questions answered correctly from 11 comparable data sets	Mean score - 12.4 Collected from May 2014 onwards prior to start of each programme	Mean score – 14.4. *P>0.5 so data not significant at the 5% level* Collected after each programme, but majority of data from September 2015
Increased teacher confidence	*E-Survey or paper survey*	113 attendees invited to respond both pre- and post. 127 pre-survey responses 25 post-survey responses	*Mean score based on 1-9 scale for each statement and total overall scores from 25 comparable data sets (1-I can't do anything, 3-I can do very little, 5-I have some influence, 7-I can do quite a bit, 9-I can do a great deal)	Mean score – 6.3 Mean total score – 101.1 Collected prior to the start of each cycle	Mean score – 7.3 *Significant at the 0.1% level as P<0.001* Mean total score – 115.8 *Significant at the 0.1% level as P<0.001* Requested at the end of each cycle up to September 2015

*data only analysed where comparable pre-and post- data were available

Table 9b - Non-Specialist teacher intervention started: September 2014

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
Increased subject knowledge and greater awareness of subject specific teaching methods in Science and Maths	*Electronic or paper pre- and post-CPD subject tests*	167 attendees invited to respond both pre- and post- tests. 206 pre-event responses 206 post-event responses	*Mean score of total number of questions answered correctly from 206 comparable data sets	Mean score – 3.2 Mean total score – 39 Collected from September 2014 onwards prior to start of each CPD session	Mean score – 3.9 *P>0.5 so data not significant at the 5% level* Mean total score – 45 *P>0.5 so data not significant at the 5% level* Collected after each CPD session from September 2014 onwards
Increased teacher confidence	*E-Survey or paper survey*	167 attendees invited to respond both	*Mean score based on 1-9 scale for each statement and total overall scores	Mean score – 5.8	Mean score – 6.5 *Significant at the 1% level as P<0.01*

| | | pre- and post.

146 pre-survey responses

46 post-survey responses | from 46 comparable data sets

(1-I can't do anything, 3-I can do very little, 5-I have some influence, 7-I can do quite a bit, 9-I can do a great deal) | Mean total score – 91.5

Collected prior to the first CPD session teacher registers for | Mean total score – 102.3
Significant at the 1% level as P<0.01

Requested after CPD sessions up to September 2015 |

*data only analysed where comparable pre-and post- data were available

Table 9c - Specialist teacher intervention started: November 2014

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
Increased subject knowledge and greater awareness of subject specific teaching methods in Science and Maths	*Electronic or paper pre- and post-CPD subject tests*	119 attendees invited to respond to both pre- and post-event tests 81 pre-event responses 46 post-event responses	*Mean score of total number of questions answered correctly from 46 comparable data sets	Mean score – 5.5 Mean total score – 49.2 Collected from November 2014 at the start of each CPD session	Mean score – 7.0 *P>0.5 so data not significant at the 5% level* Mean total score – 56.3 *Data significant at the 5% level as P<0.5* Collected at the end of each CPD session from November 2014 onwards.
Increased teacher confidence	*E-Survey or paper survey*	112 attendees invited to respond both pre- and post. 79 pre-survey responses 38 post-survey responses	*Mean score based on 1-9 scale for each statement and total overall scores from 38 comparable data sets (1-I can't do anything, 3-I can do very little, 5-I have some influence, 7-I can do quite a bit, 9-I can do a great deal)	Mean score – 5.9 Mean total score – 94.7 Collected prior to the start of each cycle	Mean score – 6.6 *Significant at the 1% level as P<0.01* Mean total score – 106.4 *Significant at the 1% level as P<0.01* Requested after CPD sessions up to September 2015

*data only analysed where comparable pre-and post- data were available

8.1.1 Summary

In the Evaluation Framework, the project proposed sampling the data returns from teachers and taking a representative sample from attendees at each Hub school event. This was based on the theory that data collection would be facile for the project team (and made simpler for participants) by using the electronic portal. Teachers were disinclined to using the portal and so data collection was slow, despite every effort from the project team. In some cases, verbal reports from teachers indicated that the portal was an increase to their workload– either schools had similar systems in place and they were reluctant to add another one to their administrative load, or they did not check emails or interact electronically with regularity and were resistant to changing this. As a result, the amount of data returned was limited across some aspects of the programme and consequently all data was analysed, rather than a sampled approach. Using all data provided is likely to skew how representative the data is in terms of teacher profiling. In addition, it is worth noting that no comparison groups were analysed for the teacher impact data.

The return rate was significantly lower for the Primary programme (ca. 9% for the subject knowledge tests) than the Secondary programmes. This is likely to be a consequence of changes to data collection procedures as the project progressed – the Secondary programmes started later and the team had begun to use paper based surveys and tests to attempt to minimise the data collection problems.

The team was surprised by the lack of response within the Primary programme: as teachers attended more sessions and received physical resources to use in schools, it was anticipated that their response rate would be higher due to perceived 'buy-in'. Regardless, qualitative feedback was exceptionally positive for the Primary programme, with regards to self-confidence, which reinforces the quantitative data received from the 25 data samples available. It is worth noting that the majority of post-programme feedback was generated in September 2015, as a result of a telethon due to the low response rate prior to this.

> *"It has given me more confidence."*
>
> *"I feel more energised."*
>
> *"I have the confidence to look at a wider range of approaches…"*
>
> *"It has given me the confidence to go outside of the curriculum…"*

The impact on teacher confidence was calculated to be statistically significant despite the limited responses obtained. Figure 8.1 shows the average reported level of confidence for all three programmes, and Section 8.4 outlines some of the qualitative comments received from Primary school teachers, with most including phrases akin to those shown on the right hand side.

Subject knowledge also appeared to increase for the Primary teachers during the programme – indicated by the average test scores increasing after engagement - but analysis deemed the effect to not be statistically significant. Again, qualitative feedback for this area was positive, with some teachers commenting on impact on specific areas of their knowledge, however the comments tended to focus more on confidence and the effectiveness of the CPD style than perceived increases in knowledge. Sample comments are shown below.

> *"I reviewed information about all of the planets (and their moons), refining my subject knowledge."*
>
> *"I did not have the knowledge of blood test analysis before the course but now feel very confident that I would be able to introduce it into the classroom."*
>
> *"I felt most out of my depth before attending the robotics session but was inspired by the understanding that was taught throughout the delivery/activity and would now feel confident delivering this to a class of students."*

For both the non-specialists KS3 and specialists KS4 Secondary programmes, the data collection methodology was similar. Levels of data return were higher for both the confidence surveys and knowledge tests but, as with the Primary programme, all data was analysed rather than utilising a sampled approach.
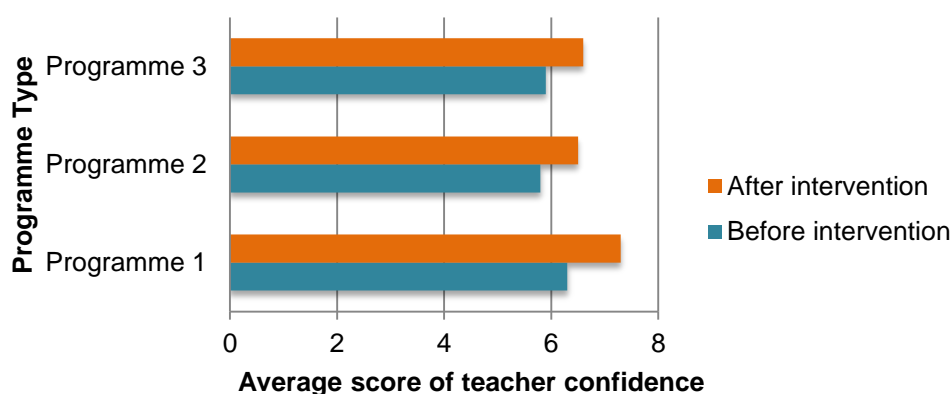

Figure 8.1 – Comparison of the average score for confidence reported by teachers before and after CPD intervention

For the non-specialists programme, the average self-reported teacher confidence increased after the CPD event(s) when compared to their pre-event answers – this was found to be statistically significant at the 1% level, despite the limited response rate. The same was true for the specialists programme – reported confidence was found to be higher after attending CPD events and was found to be statistically significant. As before, this is demonstrated in Figure 8.1. This was as the team expected, especially in the time frame of self-reporting – which was after the conclusion of the CPD events. Qualitative feedback was more focused on new knowledge with the Secondary teacher cohort, rather than perceived increases to confidence. Some teachers did comment on their confidence but these comments were more limited and reflective of what this meant for their teaching.

> *"This has shored up my own understanding. When you are confident as a teacher this always rubs off on the learners"*
>
> *"The sessions did not increase my confidence in terms of teaching they reinforced my commitment to practical science and the need to invest time, energy and planning into skills development in all abilities"*

It would be interesting to re-survey teachers in a future situation with the same questionnaire to see if the confidence has been maintained.
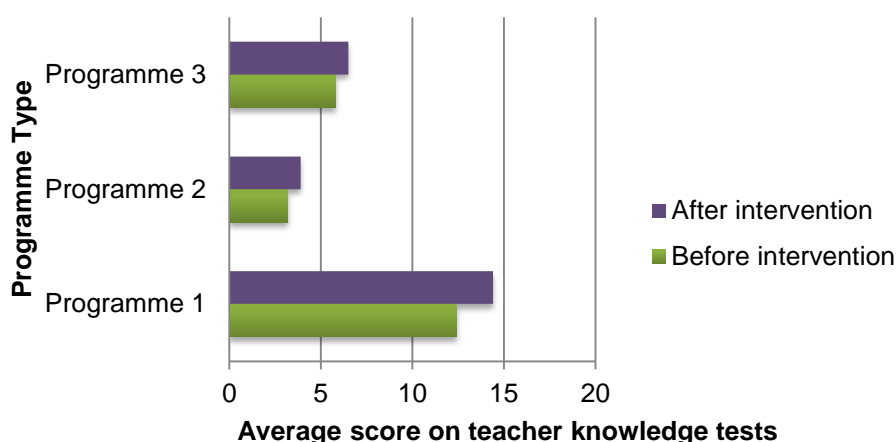

Figure 8.2 – Comparison of the average score for subject knowledge before and after CPD intervention for all three programmes.

Similarly, teacher's knowledge, as measured by the subject tests before and after the CPD sessions, was shown to increase for all programmes, as demonstrated in Figure 8.2. However, it was not found to be statistically significant within the non-specialists programme despite having the highest data return of any part of the project. The team believe this to be due to the timings of the post-event tests – most were taken immediately after the CPD session and so the variance in the data is small. The knowledge increase for the specialists programme was found to be statistically significant at the 5% level for the average total scores in the tests. Comments such as ones in the box below show that teachers involved in this programme enjoyed the opportunity to learn and provided an insight into the different understanding, awareness and applications they received from the CPD sessions.

> *"Use some of the examples covered to provide interesting, real-life context to some of the science topics taught at KS3-KS5."*
>
> *"I feel more informed and I think it has given more depth to my teaching of this topic area."*
>
> *"I attended 'Brain function and obesity'. All of it interested me and it felt really good to hear from a top researcher in her field. I took copious notes and certainly will be able to enrich my teaching with relevant, up to date examples from the areas she covered. It was also refreshing to learn for learning's sake and to feel a greater clarity about aspects of obesity, for my own sake."*
>
> *"I will use the training principles will be used to update the current KS3 curriculum and current lessons in KS3/4."*
>
> *"This will change my practice to a significant extent. The approach of hand on learning is integral to establish the right platform from which children can question effectively."*

8.2 Pupil Outcomes

Pupil interventions are measured as being started in September 2014, but roll during the year, as and when their teachers have taken part in CPD sessions.

Pupil Outcomes for pupils benefitting from the project

Table 10a - School 2 pupil intervention started: September 2014.

Target Outcome	Research method/ data collection	Sample characteristics	*Metric used*	Improvement seen and dates of collection	*Metric Used*	1st Return and date of collection	2nd Return and date of collection
Increased educational attainment and progress in Science	*Pupil assessment data for Y7*	Assessment data analysed for 1393 of 1428 year 7 students.

1332 students were part of the intervention group.

61 students made up the comparison group. | *Mean of the improvement in grade between Autumn and Summer terms.* | Mean improvement for the intervention group – 1.1, collected September 2015.

Mean improvement for the comparison group – -0.1, collected September 2015. *P<0.05 so significant at the 1% level.* | Mean percentage scored in half-term assessment in science.

1st return is from Autumn and the 2nd is from Summer. | Mean percentage of intervention group – 38.8%, collected September 2015.

Mean percentage of the comparison group – 36.5%, collected September 2015. | Mean percentage of intervention group – 50.6%, collected September 2015. *P<0.5 so significant at the 5% level.*

Mean percentage of the comparison group – 35.7%, collected September 2015. *Not enough data to be significant.* |
| | *Pupil assessment data for Y8* | Assessment data analysed for 1111 of 1251 year 8 students.

1111 students were part of the intervention group.

No data was available for a comparison group. | *Mean of the improvement in grade between Autumn and Summer terms.* | Mean improvement for the intervention group – 0.8, collected September 2015. | Mean percentage scored in half-term assessment in science. 1st return is from Autumn and the 2nd is form Summer. | Mean percentage of intervention group – 51.6%, collected September 2015. | Mean percentage of intervention group – 60.1%, collected September 2015. *P<0.5 so significant at the 5% level.* |

*a negative number represents a decrease in attainment.

Table 10b - School 3 pupil intervention started: September 2014.

Target Outcome	Research method/ data collection	Sample characteristics	*Metric used*	Improvement seen and dates of collection	*Metric used*	1st Return and date of collection	2nd Return and date of collection
Increased educational attainment and progress	*Pupil assessment data*	Assessment data analysed for 50 of 53 year 10	*Mean of the improvement in grade between*	Mean improvement for the intervention	Mean grade scored in half-term assessment	Mean grade of intervention group –B,	Mean grade of the intervention group –C+,

in Science		students. 24 students were part of the intervention group. 26 students made up the comparison group.	Autumn and Summer terms.	group – -2.7, collected September 2015. Mean improvement for the comparison group – 0.6, collected September 2015. *P<0.05 so significant at the 1% level.*	in science. 1st return is from Autumn and the 2nd is form Summer.	collected September 2015. Mean grade of the comparison group –C-, collected September 2015.	collected September 2015. *P<0.05 so significant at the 1% level.* Mean grade of the comparison group –C, collected September 2015. *P<0.5 so significant at the 5% level.*
Increased take up of specific subjects	*Student survey gathered by school*	27 students from the intervention group were surveyed.			Number of students studying triple science GCSE.	Number of students from the intervention group studying triple science GCSE – 0, collected September 2014.	Number of students from the intervention group studying triple science GCSE – 2, collected September 2015.
Heightened long term ambition	*Student survey gathered by school*	27 students from the intervention group were surveyed.			Number of students planning to take a STEM subject at A Level.	Number of students from the intervention group planning to take a STEM subject at A Level – 0, collected September 2014.	Number of students from the intervention group planning to take a STEM subject at A Level – 2, collected September 2015.

*a negative number represents a decrease in attainment.

8.2.1 Pupil Beneficiary Summary

The project team were able to collect data from two of the Hub schools, representing 21.4% of schools participating in the non-specialist teacher intervention and 5.9% of the schools participating in the specialist teacher intervention. These samples represent 64 and 13 teachers from each intervention respectively. All data collected was therefore analysed due to the small amount available. It is not possible to determine if the combined sample of 2554 students is representative of the whole programme as data for the number of students each teacher impacted are not available. Consequently, the amount of data available to analyse was too limited to produce conclusions that could be extrapolated across the programme with any confidence. No qualitative data was analysed for the pupil beneficiaries: pupils were not directly surveyed.

In addition, the comparison groups consisted of 87 students, whereas the intervention groups totalled 2467 students. Students from two different schools in two boroughs form the comparison groups, while there were 71 different Secondary schools participating in the programme from 28 boroughs. As seen in Section 7.2.1, student sub-groups vary widely across London and it can be concluded that the sample of comparison groups is too limited to be representative. Unfortunately this was the only information available to the project team and, as before, all the data was analysed.

Both the group's mean result and the group's mean improvement were calculated. The mean result shows the attainment of groups in comparison to the rest of the cohort. This is not a fair comparison

since the assessment criteria may not have been consistent between data sets from which the samples were collected. The mean improvement shows how a student may have achieved a higher grade at the end of the academic year than the beginning. This is a better comparison because it does not account for individual attainment but focuses on the individual ability of the student to improve.

School 2 provided academic information for students in both years 7 and 8 while School 3 provided data for students in year 10. Without an even spread of ages from all schools and an accurate representation by the groups of the students affected by the programme, it is hard to make a comparison between the two.

A reasonable improvement in attainment can be seen for the year 7 intervention group from School 2, which is demonstrated graphically in Figure 8.3 This improvement is statistically significant but the project team has not been provided with the tests that the students took. It may be the case that the first test was not the same level of difficulty as the second. This improvement therefore is not necessarily representative. The comparison group is not representative of schools in London since it is a newly opened academy with only a year 7 cohort – the groups have simply been matched based on year group. The teaching quality and experience may be less than expected from the intervention group sample. This implies the mean diminishment in students' grades is unlikely to represent all schools who did not participate in the programme. The peak for a -3 grade changes between autumn and summer terms will lower the mean, although there is a +1 grade change for the mode of both the comparison and intervention groups. Although the data might imply a greater improvement in the intervention group's grades, it could also be argued the improvement in attainment for both groups of students was the same.
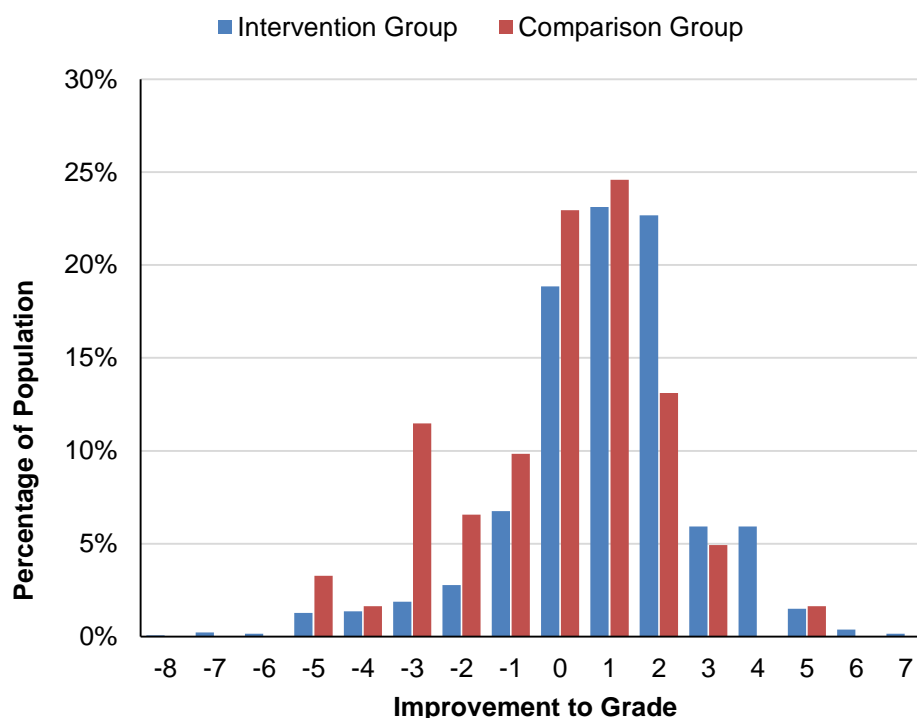

Figure 8.3 – The improvements in attainment for Y7 students in the intervention and comparison groups.

Unfortunately there is no comparison group for the year 8 students from School 2 since the project team did not receive attainment information for year 8 students who were taught by a teacher not participating in the programme. Again, there is a statistically significant improvement in attainment. The mean percentage score went from 51.6% to 60.1%, however it is not fair to conclude that the teachers' participation in the programme was the only factor contributing to this rise. On a class-by-class basis, it could be due to a change in teacher, an easier second test or many other aspects.

When analysing the data supplied by School 3, it is important to remember the limited data given to the project team. The innovation group is made up of 24 pupils and the comparison group is 26

pupils. Although the data is statistically significant, this does not guarantee a true trend or only one cause for any apparent trend. The team were not told if the two groups were assessed using the same method, either for the two results within each group or the results from each group. For a fair comparison, all students whose results were recorded should have been given the same assessment of a similar difficulty to any previous tests where data was recorded.
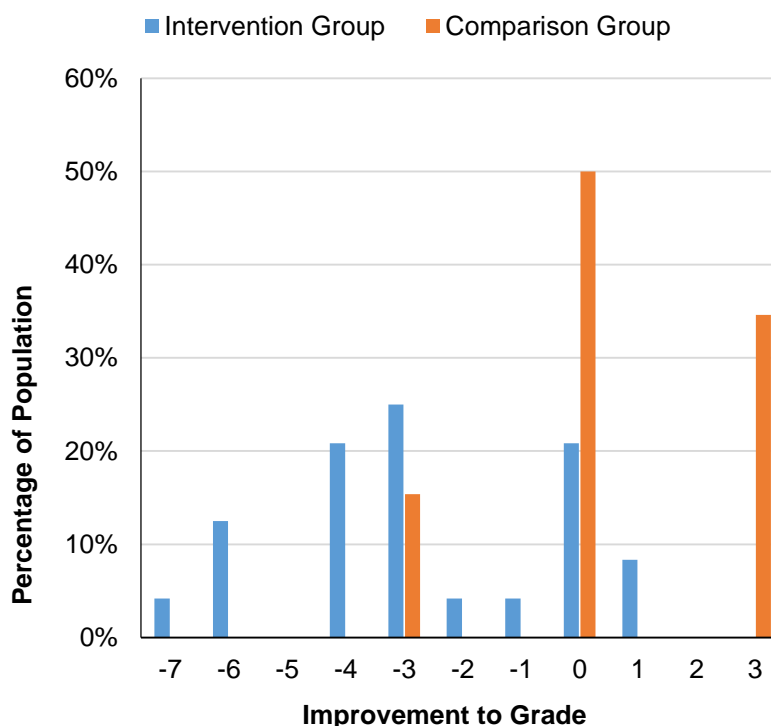

Figure 8.4 – The improvements in attainments for Y10 students in the intervention and comparison groups.

The year 10 students in the intervention group appear to have declined in academic ability, with their class mean dropping from a B to a C- between autumn and summer terms, which is demonstrated graphically in Figure 8.4. The comparison group appears to have improved in ability by the same amount, going from a class mean of C- to C. A similar trend is seen when comparing the mean improvement of the class. The comparison group appear to have improved by 0.6 points (see Table 11 for a grade equivalent) although the intervention group has declined on average by 2.7 points. From examination of the raw data, it is deemed likely that something has happened during the year to either the grading system or the assessment criteria set by the teacher. Figure 8.4 shows that the modal improvements are very similar to the mean improvements for each group; a mode of -3 points change compared with a mean change of -2.7 points and a mode change of 0 compared to a mean change of 0.6 for the innovation and comparison groups respectively. As before it is not fair to conclude that the programme is the only or even the main reason for the change in grade.

Table 11 – Conversion of grade equivalents for Figure X.

Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E+	E
Numerical Equivalent	10	9	8	7	6	5	4	3	2	1	0	-1	-2

e.g. A change of +2 in grade is equivalent to moving from a C to a B-, a change of -3 in grade is equivalent to moving from a B to a C.

School 3 also provided information on whether students would continue to study STEM subjects at A Level alongside whether a student was studying double or triple science at GCSE. There was a 7.4% increase in the number of students studying triple science at GCSE, where previously every student in the intervention group was taking double science GCSE. This is the same increase in the number of students planning to continue studying STEM subjects at A Level. Originally, when asked in the autumn term, all students were considering the possibility of continued STEM study post-GCSE. When asked again at the end of the academic year, two of the students were certain they would be

studying STEM subjects. This is the desired outcome of the programme, however as ever it is hard to determine the exact reason for this change and it cannot be accounted to the programme alone.
The method for which the schools gathered the students' achievement data was not shared with the project team and without this information it cannot be assumed that the progress shown by students is representative of the students' real progress. Ideally the team would set the tests and ask students to complete it twice every academic year for several years after the programme to monitor the long-term impact it had on attainment. Using such information for a short term impact investigation is not ideal and without having more information it is impossible to conclude any improvements were present and if they were truly due to the programme or, in fact, as is more likely, due to some other influence.

8.3 Wider System Outcomes

Table 12 – Wider System Outcomes

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
Teachers / Schools involved in intervention making greater use of networks, other schools and colleagues to improve subject knowledge and teaching practice	Electronic survey	All participants invited to respond. 97 responses in 2014 171 responses in 2015	Average number of events / meetings in each year of the programme	Average number of events attended – 1.4 Mean total events attended – 139.5 Collected from June 2014 to December 2014.	Average number of events attended – 1.3 P>0.5 so is not significant at the 5% level. Mean total events attended – 230.5 P<0.5 so is significant at the 5% level. Collected from January 2015 to September 2015.

8.3.1 Summary

As with other aspects of the data, the project team analysed all data available to them, rather than using a sampled approach. Therefore, the data analysis may not necessarily be representative of the population that interacted with the project, as certain groups may have been more likely to respond than others. In addition, initial hopes for this area of data collection and analysis were that the teachers would be asked the same question prior to commencing the project and again at the end. Logistically, this has not worked, as teachers have been reluctant to complete feedback forms after interventions have concluded. As such, the team decided to compare responses from 2014 to those gathered in 2015. More responses were received in 2015, as the programme held more CPD events in this year than in 2014.
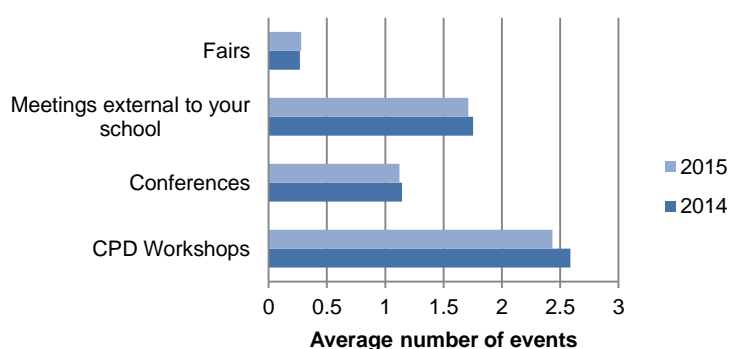

Figure 8.5 – The number of external events teachers reported attending in 2014 and 2015.

The data in Table 12 is deemed to be significant for the amount of events attended. This is thought, however, to be due to the variance in the number of events rather than a result of the project. Analysing the average number of events attended showed consistency between 2014 and 2015, as Figure 8.5 demonstrates. There is little variance and as such the data was statistically deemed insignificant.

Teachers were more likely to have attended CPD workshops and meetings external to their own school and didn't go to fairs external to their school. There is little change across the two years of the project and no significant increase in 2015 as hoped.

The level of engagement between teacher mentor and mentee on the portal was thought to be an effective model for school to school / teacher-to-teacher engagement. Unfortunately, the levels of participation were too low and, despite every effort from the moderators of the portal to keep engagement, conversations, and sharing of best practice flowing on the site, teachers were disinclined to use a system similar to those in their own schools. As an additional benefit, the resources from the programme were hosted on the site to encourage teachers to login and explore the breadth of materials available to them but were found to have no effect.

591 registered users — 513 mentees & 77 mentors

156 from mentees & 5 from mentors — 161 logins overall

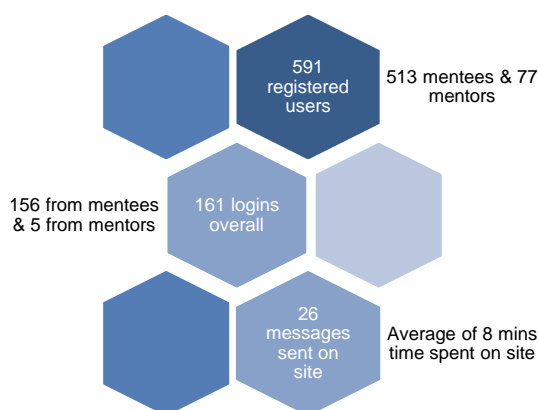26 messages sent on site — Average of 8 mins time spent on site
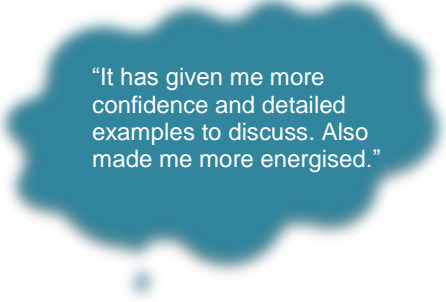
Figure 8.6 – The number of portal users

Figure 8.6 shows the facts and figures from the portal, demonstrating the low level of participation within this aspect of the project. The project team decided that, rather than continuing to push an unwanted initiative, the focus should be on ensuring that teachers could benefit from the face-to-face interactions of the project. Therefore the portal was not included into qualitative surveys and so no further data could be gathered from this aspect of the programmes.
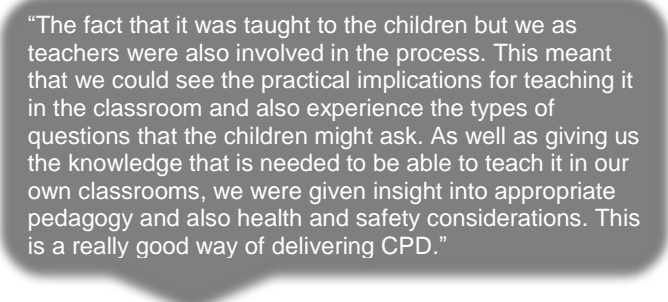
8.4 Impact Timelines

The Reaching Further Programme was designed to provide teachers with the skills and knowledge to undertake practical science investigations in the classroom. Stand-alone CPD workshops provided teachers with an immediate understanding of STEM topics or links to current research that could be immediately discussed in a classroom environment. In the case of the Primary programme, teachers were additionally provided with supporting STEM resources - encouraging activities to be undertaken with confidence, enthusiasm and little delay upon returning to the classroom. Comments from teachers have highlighted that, for the most part, impact was immediate, with most reporting increased enthusiasm and confidence.

"This has shored up my own understanding. When you are confident as a teacher this always rubs off on the learners. So it will make some difference to my teaching of this topic."

"We have already carried out many of the activities with the rest of year 5. They really enjoyed the sessions and the year 4 children are already looking forward to science in year 5 because they want to build their own dome. We want to make these sessions part of our Year 5 science curriculum and the robots will be used in ICT throughout upper KS2."

"It has given me more confidence and detailed examples to discuss. Also made me more energised."
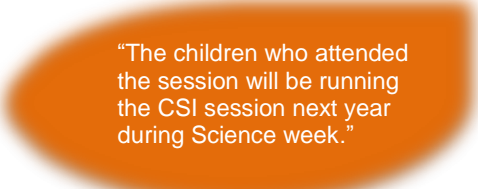
"The fact that it was taught to the children but we as teachers were also involved in the process. This meant that we could see the practical implications for teaching it in the classroom and also experience the types of questions that the children might ask. As well as giving us the knowledge that is needed to be able to teach it in our own classrooms, we were given insight into appropriate pedagogy and also health and safety considerations. This is a really good way of delivering CPD."

Most teachers involved in the Primary Programme indicated verbally during CPD sessions that they were planning to share the outcomes with pupils immediately. Others indicated that the activities were to be included in wider curriculum planning for the 2015/2016 academic year.

Non-specialist teachers participating in the KS3 Programme 2, designed to support those teaching outside their area of specialism, have commented that the skills, knowledge and confidence gained from the workshops has enabled STEM topics to be taught immediately to pupils, especially in "struggle" areas such as those covered by the GCSE Physics curriculum.

Specialist teachers involved in the KS4/5 Programme 3 have commented that the workshops led by Imperial College researchers has enabled them to acquire high-level learning with direct links to real-life areas.
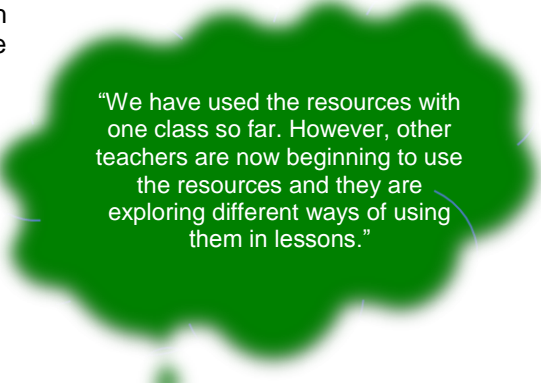
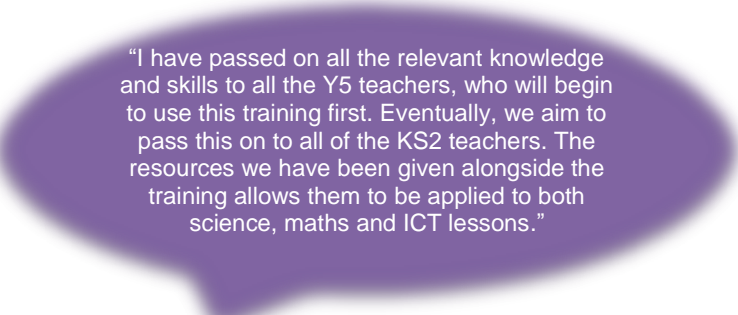"The children who attended the session will be running the CSI session next year during Science week."

"I plan to implement some of the activities and concepts into STEM activities and topics with pupils."

With wider school outcomes, the bulk of the impact is expected during the current academic year (2015-2016) for all programmes. Culture change typically takes longer to embed but many teachers have mentioned that they will be continuing to work with schools in their local areas in the coming years, or have found positive outcomes from bringing larger groups of teachers together and benefited from the range of experiences on offer.
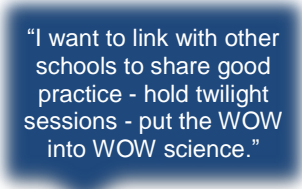
The Primary programme was designed to provide reusable resources aimed at extending the longevity of the programme, ensuring continuing impact for future cohorts of students within the school. The programme promotes activity sharing and cascading to other teachers within a school community or with associated partner schools, especially where resources are available which support INSET days, transition activities and extended project work with other disciplines. It is clear from comments provided by attendees within the Primary programme that this has been successful and these benefits have already started in schools, leading to creative thinking and planning.

"We have used the resources with one class so far. However, other teachers are now beginning to use the resources and they are exploring different ways of using them in lessons."

"I have passed on all the relevant knowledge and skills to all the Y5 teachers, who will begin to use this training first. Eventually, we aim to pass this on to all of the KS2 teachers. The resources we have been given alongside the training allows them to be applied to both science, maths and ICT lessons."

"I want to link with other schools to share good practice - hold twilight sessions - put the WOW into WOW science."

9. Reflection on overall project impact

The project's Theory of Change was predicated on the view that disengagement and illiteracy in STEM occurs because of the lack of positive and informative experiences at individual, school, community and cultural level. Reaching Further was designed to impact on factors which contribute to disengagement, such as a lack of hands-on practical experience of STEM. The project team holds a strong belief, drawn from over 30 years of experience, that this is a major factor in contributing to an increase in disengagement with the STEM subjects.

Practical science is a key motivator for Primary and Secondary students, however it is too often the case that pressure of limited time coupled with inadequate facilities and resources in some schools conspire against a practical approach. A number of publications, including those of The Royal Society of Chemistry, point to deficiencies in science teaching at Primary and Secondary level which arise from a lack of subject specialist teachers, resulting in reluctance by teachers to engage in the practical application of science within the classroom.[5]

The Reaching Further project was driven by the theory that supporting non-specialist teachers of STEM at Primary and Secondary level and raising their confidence levels would encourage more practical hands-on engagement in STEM study.

The Primary workshops proved to be very popular, capturing the appetite for STEM knowledge acquisition combined with the provision of reusable STEM resources. Schools welcomed the opportunity for teachers to acquire new, interesting and fun STEM activities. Feedback from teachers specifically focused in many cases on the opportunity the programme provided to engage more able pupils as STEM Mentors. The project initially aimed to attract 100 teachers from 80 schools but due to its popularity, format and resources, resulted in 113 teachers from 80 schools participating in the programme. Initially, the project had 141 teachers from 90 schools signed up to take part but numbers are lower due to non-attendance at scheduled sessions, as discussed in the next section. The aim of the Primary programme was to embed sustainable activities, equipment and resources that will enable future multi-cohorts of students to benefit. The programme has initially enabled approximately 3,400 pupils from London Boroughs to engage in enriching and enhancing STEM engagement, exploring scientific investigation processes, raising and developing interest in STEM subjects and dispelling misconceptions that STEM subject are boring. It is envisaged that the programme will, in the longer-term, provide pupils with a sound foundation of STEM interest and understanding through secondary school and beyond. From Section 8.1 and 8.4 of this report, it is demonstrated that teachers have genuinely enjoyed participating and have seen the benefits of participation – for themselves, their colleagues and their students.

Programme 2 workshops were tailored to encourage and support science teachers whose discipline is not in the STEM subject they are teaching, increasing their confidence in practical science. Teachers were keen to participate in workshops that gave help and practical tips on dealing with difficult concepts, with greater numbers of teachers teaching these areas outside their specialism.

Programme 3 successfully linked subject specialist teachers to current research, providing a mechanism for developing curriculum content with new practical activities to aid aspiration and inspiration for students. Teachers expressed great interest in working with Imperial College London academics - certain workshops such as Brain Function and Neurology proved to be particularly popular with KS5 teachers. Although some workshops could not be replicated in their entirety, they did provide vital stimulus for teacher adaption and knowledge for cross-reference when discussing and debating similar topics with students. This was especially useful where ethical considerations were a factor. From Section 8.1 and 8.4 of this report, it is demonstrated that teachers have enjoyed taking part in the majority of workshops and have been able to critically evaluate where their learning can be applied in school.

The project relied on the use of Hub schools as a delivery model, which, overall, has been beneficial to the operation of the programmes. Teachers who have fed back from the Hub schools have been mostly positive about the benefits of the model, with the predominantly negative comments being related to the high levels of feedback and reporting they needed to facilitate. The Hubs allowed for more efficient recruitment of teachers via teaching alliances or personal connections and schools have enjoyed forging closer relationships, especially those with their Primary schools.

The true downstream impact of the programme cannot, as yet, be fully assessed as CPD impact on teachers has only just begun to take effect in the classroom. It is anticipated that the project's Theory of Change model and the long-term effect of this programme will be even more teachers confident to engage in STEM enrichment activity. It is hoped that the approximately 400 dynamic teachers, equipped with a STEM toolkit of knowledge and resources, will inspire London's young people and create a centre of excellence for knowledge-led STEM teaching. Early indications, as discussed, are positive, with quantitative and qualitative feedback indicating an increase in teacher confidence and knowledge and downstream impact on students to come. At the time of reporting, the data has not provided full confidence as to whether the LSEF hypothesis is supported but indicators are positive. Additional follow-up work and data analysis would be required to determine the hypothesis with more certainty.

The UK Government's Science and Innovation Investment Framework (2004) set out a ten-year plan for UK Science and Innovation contribution to economic growth and public services.[6] A central part of the Framework included actions to achieve a step change in: the quality of science teachers and lecturers in every school, college and university; the results for students studying science at GCSE level; the numbers choosing STEM subjects in post-16 and higher education; and the proportion of better qualified students pursuing R&D careers. Great strides have been made to implement new measures to further improve the teaching of STEM subjects by boosting investments in the recruitment and training of specialist science teachers, improving STEM careers advice and doubling the number of science and engineering school clubs. In October 2006, the DfES (Department for Education and Skills, now the DfE) and DTI (Department for Trade and Industry, now the DIUS) published the STEM Programme Report, which documented the aim to better coordinate the organisations involved in STEM education.[7] The report identified the need to enhance the effectiveness of Government funding in two areas: the flow of qualified people into the STEM workforce and STEM literacy in the population.

These positive moves take time to evolve, requiring a great deal of time and commitment from partnering organisations. It is hoped that through projects such as the Imperial College London Reaching Further Project and other in-house programmes, London schools, teachers and students are starting to benefit from a rise in teacher recruitment and retention, continuing professional development, enhancement and enrichment activity, and curriculum development, with positive effects for London and the UK as a whole.

10. Value for Money

10.1 Apportionment of the costs across the activity

Broad type of activity	Estimated % project activity	£ Estimated cost, including in kind	Estimated % cost
Producing/Disseminating Materials/Resources	15%	£186,123	31%
Teacher CPD (face to face/online etc)	60%	£320,690	53%
Events/Networks for Teachers	20%	£93,820	15%
Teacher 1:1 support	5%	£10,110	1%
Events/Networks for Pupils	0%	£0	
TOTAL	**100%**	**£610,743**	

The project team feel that overall the balance of project activity was approximately right. While the amount of time spent on actual CPD should be the predominant commitment, it would be interesting to explore whether providing more commitment to 1:1 support would produce a higher level of feedback from participants.

In addition, the proportion of costs does roughly balance to the proportion of activity, indicting that initial predications were accurate. The only major discrepancy is the expense of the production and dissemination of resources, which has cost over 30% of the budget, whilst accounting for approximately 15% of the activity.

The team believes that more Primary activities would have been beneficial as Primary teachers seemed to particularly welcome this opportunity but data collection would need to be reviewed as the

feedback was more limited than the secondary programmes. In hindsight, the online portal, which cost approximately £30,000 to create and maintain during the project is an area where costs could be better utilised, and the team wouldn't recommend using such a system unless it was one already used within schools.

10.2 Commentary of value for money

Determining value for money is not easy for this type of project, due to the size, scope and number of different stakeholders with different expectations. Feedback from the teachers, and school leads, has, for the most part, been favourable though the project has not managed to connect with as many teachers as hoped for. Outputs are lower principally due to lower levels of attendance per workshop however the cost per workshop is fixed, so there were no clear savings to be made.

Teacher knowledge and confidence has increased by participation in the project, but the team have been unable to demonstrate a link between participation of teachers in the programmes to an increase in pupil attainment. More work would be needed over a longer period of time to be able to demonstrate lasting effects on pupil attainment. In an environment with less competition from other programmes, the project may have been able to demonstrate a higher output of beneficiaries.

11. Reflection on Project Delivery

11.1 Key Enablers and Barriers to Achievement

The key enablers came from two major parts of the programme:

- *The relationships with the Hub schools.*

This seemed to be a good mechanism for project delivery. The Hub schools, and the teachers from those schools, were integral in pushing the project forwards. Their involvement in their Primary feeder schools and local Secondary schools supported the recruitment of teachers onto the CPD sessions effectively, if not in great number.

- *Provision of reusable resources to Primary schools.*

This was well received by the Primary teachers and instrumental in ensuring the success of the Primary programme. From the feedback received, it was clear that the resources are already on their way to having a legacy in schools. Many teachers have been discussing resource implementation by other colleagues and the consideration of schemes of work for the upcoming year that utilised the resources.

There were obviously a number of barriers, many of which have been alluded to during the report, and these had a significant effect on the operation and delivery of the project:

- *Delayed start to the programme.*

This hugely impacted on the success of the programme. It coincided with changes to SAT assessments for Primary schools, making the evaluation data requirement almost obsolete. It reduced the timings for the workshop so that the two-year programme was shortened to one year, limiting the ability for the team to measure impact, especially on pupils.

- *Teacher workloads.*

The high workload in schools has limited teacher willingness to engage in twilight CPD sessions in their own time, as many academies contractually require teachers to work from 08:00 to 17:30. Although anecdotally it was found that most teachers have a willingness to engage in CPD opportunities, the need to travel in the evening to those workshops, and then participate was reported to be too tiring for many.

- *Location of the workshops.*

Although the Hub schools were originally identified to cover wide areas of London, the reality was that all but one was based in the southern part of the capital. Transport links in this part of the city were not flexible enough to encourage teachers to participate in the workshops and so fewer teachers attended workshops than had originally signed up to participate.

- *Exam periods.*

Schools do not allow teacher release before and during the exam season. This severely impacted on workshops from May through to July, which saw several workshops postponed due to lack of response from teachers. To address this point, they were rescheduled to run at another, more convenient time and the project arranged CPD days during which participants could attend more than one workshop to maximise their time out of school. With a longer delivery period, more flexibility for the teachers would have been possible.

- *Tube strikes.*

Industrial action impacted on at least four workshops, which were postponed at short notice. The opportunity to continue delivery after September 30th has enabled the project to reschedule most of these workshops but not prior to the reporting deadline. This has limited the number of teachers and data that is reportable.

- *Workshop saturation.*

Many other STEM projects were running at the same time with similar CPD workshops and outcomes. To overcome this, workshops were offered that were not traditional topics and instead supported the informal rather than the formal curriculum. For Programme 3, it was found that drawing upon the experience of Imperial College London researchers brought to life an area of topical contemporary research in an engaging way.

- *Reluctance to use the Reaching Further portal.*

Participating teachers showed great reluctance to use the portal, which was set up to facilitate sharing of resources and as a method of communication. It could not be relied upon as a mechanism for data collection due to low uptake by the teachers. Most individual evaluation forms were completed on hard copy at the workshops and then transferred to the portal by the project team, resulting in significantly more man-hours devoted to this exercise than originally anticipated. The reporting functionality of the portal was also not as sophisticated as hoped, leading to significant data cleaning and off-site analysis that was not initially planned or costed into budgets.

- *In-school delivery.*

The initial plan was for the Hub schools to deliver a significant number of the CPD workshops themselves, especially within Programme 2. However, overall, it was found that they were reluctant to teach the workshops. One school brought in an external consultant to deliver their workshops and subsequently commented on the lack of impact these workshops had. Consequently, the project team was responsible for significantly more of the delivery of the workshops than originally intended.

- *Unachievable targets.*

The original target number of beneficiaries stated in the submission documents was, upon reflection, ambitious. The primary figures were easily achieved due to a successful and marketable combination of extensive resources and CPD. However, the secondary target beneficiaries were far more difficult to attain. Operation of the programme demonstrated that the attendance of 25 teachers at a CPD session was unachievable. In addition, attracting different teachers to each session was almost impossible, resulting in lower than proposed unique teachers involved in the project. The project team targeted teachers repeatedly using various methods, including utilising existing hub school networks, associated and affiliated schools, STEM groups, emails and social media. On the whole they struggled to attract more than 15 participants to a session. Teachers often cancelled at late notice or did not attend, especially over the winter months.

Many teachers rely heavily on teacher notes, presentations and guidance notes to be provided at each workshop, sometimes as a pre-requisite. As the project team wished for teachers to come with an open mind, participate actively and gain confidence to deliver the activities back in the classroom supporting notes were provided only to teachers who attended.

Early on in the project it was identified that insufficient resources were provided to adequately support the CSI element of the Primary programme. To overcome this issue, the project team generated additional blood typing resources, which were then despatched to all participating Primary schools. In addition, the robotics element of the Primary programme needed additional support in some cases as teachers requested extra guidance to effectively deliver the sessions in school, which the project team facilitated.

11.2 Management and Delivery Processes

The project relied heavily on a successful and experienced management team who used previous knowledge to pull the programmes together. It should be noted that significantly more work hours and resources than budgeted were required from a committed and dedicated team working on the project. In terms of evaluation, unexpected additional resources were required to pull the vast amounts of data together – a consequence of the portal not being fit for reporting on the level of data that was required for the project.

It was recognised early on that the Hub schools did not have the personnel, time or commitment necessary to adequately support the requirements of the project, as stipulated in the proposal. These requirements included the crucial areas of teacher recruitment and the delivery of workshops. This responsibility, therefore, had to be absorbed early in the programme by the project team (or recruitment would have been severely impacted and workshops not delivered). This resulted in the team delivering significantly more workshops than originally anticipated, as well as organising almost 95% of the recruitment. Hub schools were able to support the programme by hosting and advertising opportunities but were not able to commit as fully as initially outlined in their Memorandum of Understanding.

11.3 Future Sustainability and Forward Planning

In Section 4.2, it was stated that there are no plans to continue the project in its current format. In hindsight, the projected outputs were too ambitious at a time when many other initiatives were also in operation, resulting in saturation of the CPD market. However, there are plans for the College to continue to engage with teacher CPD and the positive aspects of the programme will be retained where feasible and effective to do so. The central Outreach team have staff dedicated to managing relationships with teachers and plan to undertake a number of focus groups to review the sustainability of this project and where the continuing focus should be.

Imperial College London has recently published its strategy for 2015 – 2020 and communicating and sharing the wonders of the Science and Engineering carried out is a key part of this. Working with this in mind, alongside its developing Outreach strategy, the College will continue to drive the passion for engagement with schools and teachers.

For sustainability of this project, it is key to have passionate and enthusiastic teachers, who work closely with the HEI to plan and develop the programme of activities. Time to explore the market and space to evolve ideas and activities that are based on the changing needs of the teaching community are also essential to the future of the programme. Whilst a level of evaluation is required for proving efficacy of such programmes, exploring new methods of evaluation and monitoring without impacting heavy workloads in schools is necessary for sustainability.

All the resources generated by this project are currently hosted on the Reaching Further website (the portal). This will close once the project draws to a conclusion. Over the next few months, these will be moved and will be available for download on the Imperial College London Schools website. These will also be shared on LondonEd. It is hoped that, with additional time and data, some of the knowledge gained will be publishable. With that in mind, the team aims to continue gathering data where feasible for the outstanding CPD events to generate a complete picture of the programme and to supplement resources where possible.

12. Final Report Conclusion

12.1 Key findings for assessment of project impact

Evaluation suggests that teacher confidence improved across all three programmes. This was self reported by teachers and was demonstrated by an increase in their opinions of their teaching ability after attending CPD sessions.

Data indicates that teacher knowledge also increased for each aspect of the programme. Mean test scores were higher after attending CPD sessions but the statistical analysis was not conclusive to determine whether this impact was from attending the training sessions. Further analysis and more

data are required to be more conclusive. Data from 6 or 12 months post-event would also be useful to determine whether this is due to immediate retention of facts or consequence of embedding the knowledge and later utilising it.

It was impossible to conclude whether the impact on teachers had an effect on pupil attainment. Within the delivery timeframe of the project, impact was not expected, and any data to that effect was assumed to be due to other factors external to the project. A longer period of delivery is required along with other methods of evaluating student attainment, to be able to determine impact of the CPD on pupils.
Insufficient data was available to determine whether the programme had any effect on pupil's long-term aspirations.

Statistically, there appears to have been no effect on the wider school network. Teachers do not appear to have made greater use of networks or opportunities to engage with other colleagues outside of their own school in the duration of the project. Interestingly, anecdotal data indicates that the intent is there, but this has not fed through into the statistics. Again this is an area where analysing data 6 – 12 months after the conclusion of the programme would be interesting, as culture change is likely to take longer to embed.

12.2 Key lessons learnt for assessment of project delivery

Despite the problems associated with the Hub model outlined in Section 11, there are definite benefits to the structure, in particular it produced excellent contact with Primary schools: working with Primary teachers was a key target area for Reaching Further. This was well received and remains an area where more intervention would be of benefit in the future. However, the Hub model was not as effective for the Secondary programmes. It was found that it was more difficult to bring competing Secondary schools together in one Hub unless they were already linked together, for example, in a federation of academies.

Section 11 of the report has outlined some of the difficulties encountered in delivery, such as locations and timings of sessions. The project team believes that issues akin to those would have been allayed with a longer planning and development period.

There has been focus throughout the report on the portal that was anticipated to be used for networking, communication and reporting. It was not used by the teachers and did cause significant impact on the delivery of the project as the team had to spend much more time on data entry and collation, as opposed to actual delivery. At the time of writing, a solution is not immediately apparent other than reallocation of expenditure to accommodate more staff time for data collection and analysis.

12.3 Informing future delivery

The team believe that delays in the contracting process at the start of the programme impacted on delivery timelines. There are key windows of opportunity within the school academic year for professional development activities with teachers. There are also inoperable periods, such as exam periods. The delays and time spent discussing and finalising the evaluation framework meant that proposed timelines were displaced which had a downstream implication for delivery. This increased the amount of work required to build teacher engagement numbers into the programmes.

Secondary practitioners teaching out of specialism seemed to benefit from subject-specific intervention. However, the LSEF programme as a whole seemed to produce a lot of opportunity for Physics engagement and support at the Secondary level, to the point of saturation, having a significant impact on this project. Offering more support for Chemistry and Mathematics at the expense of some of the oversupply of Physics would be prudent and better use of limited resources.

It was also unfortunate that the timescale for project delivery was not linked into changes taking place within the national curriculum, particularly in respect of KS4 and Post-16 examination requirements. The new working required for both GCSE and A-Level provides opportunity for future support through professional development. The project managed to touch on this towards the end of the period of

funding but it is felt that more could have been done with a longer delivery period – and as such is a clear area for further work and development for the College.

Finally, some of the Hubs are planning to maintain links between teachers as new examination arrangements come into effect - a beneficial legacy of the programme for both teachers and students. This is a clear indicator that the ethos of the fund, and this programme has had an effective outcome, and can be sustainable.

13. References

1. Select Committee Science and Technology Second Report
2. Joseph Rowntree Foundation
3. London Data Store
4. Collected in 2015 from schools performance tables
5. Royal Society of Chemistry report
6. Science and Innovation Investment Framework
7. STEM Programme Report, 2004

Theory Of Change Model

Disengagement and illiteracy in STEM occurs because…
of the lack of positive and informative experiences at an individual, school, community and cultural level

	Factors that may increase disengagement and illiteracy in STEM	Factors that may act against disengagement and illiteracy in stem	If these things happen	Assuming these things	Then we can expect to see these results (Short Term Outcomes)	And then we want to see these results (Intermediate Term Outcomes)	And then we hope to see these results (Long Term Outcomes)
Individual and School	Little or no hands-on or practical STEM activity	Exciting practical or field experience	Hands on Practicals	Hands-on practical activity motivates STEM learning and aspiration to continue learning	Practical STEM activities disseminated in schools	Participating students and teachers understand and are inspired by selected STEM topics and linked career pathway guidance	Improved attainment in STEM at SAT, GCSE and A Level when taught by trained teachers
	Lack of resources at school	Access to interesting equipment	Schools provided with state-of-the-art kit	Removal of obstacles to pracical work will enable this to happen	Teachers well equipped with resource material		
	Non specialist science teachers	Enthusiatic inspirational teachers	Access to fully equipped labs	Secure and comfortable environment will increase effectiveness of training and uptake of activity	Stronger links between school and research communities		Improved teaching by all STEM teachers from 85% of participating schools
	Preconception STEM subjects are difficult	Demonstrating that science is logical	Practical maths embedded attractively	Practical confidence and facility enhanced	Teachers understand STEM topics better		
	Lag in text book knowledge and current STEM research	Informed teaching staff	Engaged with industry and current research	Topics made relevant through current applications	Aware of opportunities for STEM careers	Use of resource materials by non-participating teachers in classes & school	Improved take-up of opportunities in HE & STEM related research links/industry
	Lack of context	Engagement with researchers	Teachers are refreshed by links with academics	Dynamic exchange of ideas linked to content	Opportunity for teachers to update/refresh knowledge		

Cultural and Society							
Peer groups with negative perception of STEM subjects	→	Positive role models	→	Access to respected undergraduate STEM ambassadors	→	Accurate information given to support context and opportunites	→	Improved understanding of STEM pathways	→	Postitive attitudes toward STEM	→	Increase in school and community support toward selection of STEM subjects and careers
1st generation to consider HE	→	Family support	→	Information about financial aspects of HE	→	Finance no longer seen as a barrier to progression	→	Understanding of earning potential of STEM related careers	→	Increase in Parent and Community interaction with STEM	→	Indication that specific outcomes are the result of the programme as well as any other external attributing factors
Lack of support	→	Community initiatives include practical STEM classes for parents & students	→	Invite parents and community to participate in laboratory & celebratory events	→	Wider impact on students and their families as an agent of impacting on social mobility	→	Improved understanding of STEM within wider community	→	Parents encourage offspring to think of STEM and Higher Education (HE)	→	Impact on high level data for scocial mobility

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
Teacher outcomes **Sub Groups** As part of establishing the baseline, the characteristics of the eligible cohort should be analysed across the following sub groups: ☑ NQTs ☑ 3 years + ☑ Primary/ secondary ☑ Other (project specific) These should be expressed as a % of the whole group. **Churn** Throughout the programme thorough records of any "churn" of teachers leaving or joining the intervention group must be kept. In order to do this records must be kept of: ☑ Unique teacher identifier	☑ Increased subject knowledge and greater awareness of subject specific teaching methods (1) in what subject(s)? In Science and Maths subjects	☑ Increased teacher scores in subject knowledge/ teaching method tests[iii] Tests to be taken by all teachers involved in the intervention (1a)	☑ Scores collected for individual teachers from pre intervention subject knowledge/ teaching method tests (1b) We need to generate tests based on activities that the teachers can take before they undertake the CPD. It is important that they are based on the activity content and background knowledge in the specific areas rather than general. We can do this for the Primary Programme and the Non-Specialists programme External checks are proposed to be done via the IOE/ MyScience / The Physics Factory pending further discussions with those organisations Timeframe: January 2014 and rolling Sample Size – min 30	☑ Scores collected for individual teachers from subject knowledge/ teaching method tests after Yr1 and Yr2 of intervention (1c) The impact data collection will be taken at the end of the Primary Programme and the Non-Specialists Programme and then again ca six months post intervention date Timeframe – March 2014 and ongoing Sample Size – Min 30

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
☑ Engagement date ☑ Disengagement date and reason	☑ Increased teacher confidence (2)	☑ Increased teacher scores in confidence surveys (2a) Survey to be completed by all teachers involved in the intervention. Teacher confidence surveys should be agreed with the GLA. We will add additional questions to the survey that the GLA are preparing (and not alter the existing questions)	☑ Scores collected for individual teachers from pre intervention confidence surveys (2b) This will be done for all three parts of the programme – primary, non-specialists and specialists. Timeframe: January 2014 and rolling Sample Size – Min 30	☑ Scores collected from individual teachers from post intervention confidence surveys after Yr1 and Yr2 of intervention (2c) The impact data collection will be taken at the end of the Primary Programme and the Non-Specialists Programme and at the end of Y1 and Y2. ☑ Interviews/ focus group of sample of survey respondents to moderate survey findings (2d) At end of Y1 and Y2 Timeframe – Continuous until April 2015 Sample Size – Min 30

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
	☑ Delivery of higher quality teaching including subject-focused and teaching methods (3)	☑ Improved teaching performance in observed lessons[iv] Observations to be conducted for a sample of teachers. With a small sample of those to be independently moderated[iv] (3a)	☑ Standards collected for individual teachers from pre intervention observations (i.e. percentages of teachers at each level) (3b) We will generate OFSTED-like criteria that focus on practical science lessons. These will be validated by members of the hub schools (heads of departments or head teachers) who are OFSTED trained. We will do this for the Primary Programme and the Non-Specialists programme, with a possibility of doing it for the specialists programme. Lead teachers in schools will do the observations for teachers within their own schools – i.e. Hub schools will observe their own teachers, and then provide the linked schools with the tools for them to do their own observations within their own schools. The observations will be moderated at the steering group meetings by the Heads of hub Schools and Heads of Departments within Hub Schools. Timeframe: End of each academic year Sample Size – Min 30 So 'baseline' will actually be summer 2014 – will any training have happened by then? Some minimal training will have happened by September and for that small cohort there will be both baseline data and post event data	☑ Standards collected for individual teachers from observations after Yr1 and Yr2 of intervention (3c) As in column 3b Timeframe – End of each academic year Sample Size – Min 30

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
Pupil outcomes **Sub Groups** The characteristics of the eligible cohort should be analysed across the following sub groups: ☑ LAC continuously for 6 months+ ☑ FSM ☑ FSM at any time during last 6 years* ☑ Disadvantaged pupils ☑ EAL ☑ Gender ☑ Ethnicity ☑ Statement of SEN or supported at School Action Plus ☑ Started respective Key Stage below expected level, at expected level, above expected level All characteristics should be captured as part of establishing the baseline and data should be collected to enable all outcomes to be analysed across these sub groups. **Churn** Throughout the programme thorough records of any "churn" of pupils leaving or joining the intervention group must be kept. In order to do this records must be kept of: ☑ Unique pupil identifier ☑ Engagement date ☑ Disengagement date and reason **Pupil outcomes continued…**	☑ Increased educational attainment and progress (5)	☑ Increased attainment (levels and sub levels at KS2&3 and grades at KS4) compared against a comparison group[v] (5a) We will use the Red, Amber, Green system used within schools – appears to be a standardised system across our hub schools. I know we discussed this but not sure if it was resolved – can you clarify whether this is measuring progress or attainment and if you will also have the levels/ grades behind it? Hoping to measure attainment with levels / grades. ☑ Increased levels of progress (point scores and % achieving higher point scores than expected) compared against a comparison group[vi] (5b) We will use the Red, Amber, Green system used within schools – appears to be a standardised system across our hub schools. As per comment above	☑ Intervention group: assessed level on entry to the programme and for 3 years previous (5d) ☑ Comparison group: assessed level on entry to the programme and for 3 years previous (5e) We believe that we can find comparison groups in a few of the situations – with the subject specialists and non-subject specialist programmes both Bacons College and William Perkin Academy (Hub Schools) are able to do comparison studies. It is anticipated that the group will be matched on attainment levels and FSM Timeframe: February / March 2014 and on new intake into the programmes Sample Size – Min 30 ☑ Trend data[vi]: Actual attainment (levels/grades) for the 3 previous year groups (5f) Available via the hub schools via their Red, Amber, Green system As per comment above Timeframe: February / March 2014 and rolling Sample Size – Min 30 ☑ Intervention group: estimated point score without intervention (for Y1 and Y2 of programme) (5g) ☑ Comparison group: estimated point score without intervention (for Y1 and Y as above) (5h) Comparison as above	☑ Intervention group: actual pupil attainment levels after Y1 and Y2 of intervention (5l) ☑ Comparison group: actual pupil attainment levels after Y1 and Y2 of intervention (5m) Where attainment is based on teacher assessments (i.e. not at the end of a KS) a sample of pupil assessments should be independently moderated[iv] We believe that we can find comparison groups in a few of the situations – with the subject specialists and non-subject specialist programmes both Bacons College and William Perkin Academy (Hub Schools) are able to do comparison studies Teacher assessment using standard assessments – either formal exams or mock GCSE's or equivalent Timeframe – At the end of each academic year Sample Size – Min 30 ☑ Intervention group: difference between actual attainment and expected attainment (without intervention) (5n) ☑ Comparison group: difference between actual attainment and expected attainment (without intervention) (5o) Comparison as above

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
		☑ Reduced gap between attainment of different sub-groups/disadvantaged groups of pupils (e.g. FSM, LAC, by gender etc.) compared against a comparison group[vi] (5c) We will use the Red, Amber, Green system used within schools – appears to be a standardised system across our hub schools.	☑ Intervention group: in house % points gaps between relative attainment of sub groups pre intervention and for 3 years previous (5i) ☑ Comparison group: in house % points gaps between relative attainment of sub groups pre intervention and for 3 years previous (5j) ☑ Trend data: in house % points gaps between relative attainment of sub groups for the 3 previous year groups (5k) You didn't mention trend data above so surprised it is mentioned here? We didn't include this ourselves, this is something that we were asked to do by Project Oracle. Comparison as above Timeframe: Feb / March 2014 Sample Size – Min 30	☑ Intervention group: in house % points gaps between relative performance of sub groups after Year 1 and 2 of intervention (5p) ☑ Comparison group: in house % points gaps between relative performance of sub groups after Year 1 and 2 of intervention (5q) Comparison as above Timeframe: At the end of each academic year Sample Size – Min 30

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
	☑ Increased take up of specific subjects (6)	☑ Increased numbers of pupils taking up specific subjects at GSCE, at A Level and at H/FE against a comparison group[vi] (6a) We believe that we can measure the uptake of Triple Science GCSE (Y9 – Y10 transition from the non-specialists programme) and believe that we are able to get the data for A-Level STEM subject uptake from the schools (Y11 – Y12) for the non-specialists and specialists programme	☑ Trend data: numbers of pupils taking up relevant subjects at GSCEs, A Levels and at H/FE for 3 years prior to intervention (by subject incl. any info on pupils taking two languages) (6b) Timeframe: February / March 2014 and rolling Sample Size – Min 30	☑ Intervention group: numbers of pupils taking relevant subjects GSCEs and A Levels after 12 and 24 months of intervention (analysed by subject & cohort profile) (6c) ☑ Comparison group: numbers of pupils taking relevant subjects GSCEs and A Levels after 12 and 24 months (analysed by subject & cohort profile) (6d) Timeframe: Start of new academic years when destinations are known Sample Size – Min 30
			☑ Intervention group: pre intervention survey of likely subject choices in relevant subjects at next stage (6e) ☑ Comparison group: pre intervention survey of likely subject choices in relevant subjects at next stage (6g) We believe that this can be done by tracking a sample of students via their UPN and schools will be able to do this for their pupils. See prior row for information on possible comparison groups Timeframe: February / March 2014 and rolling Sample Size – Min 30	☑ Intervention group: post intervention surveys (after Y1 & Y2) of likely subject choices in relevant subjects at next stage (6f) ☑ Comparison group: post intervention surveys (after Y1 & Y2) of likely subject choices in relevant subjects at next stage (6h Timeframe: Start of new academic years Sample Size – Min 30

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
	☑ Improved transition between primary and secondary (7)	☑ Higher percentage of pupils outperforming expectations in Year 7 against a comparison group[vi] (7a) Analysing KS2 data that all secondary schools have in their red, amber, green system – comparing number of students at each attainment level. Are you working with primary schools? If not, not sure you need to do this? We are working with primary school teachers – but if this is something that can be removed then we would be very happy with because this is proving to be fairly complex.	☑ Intervention group: assessed levels of primary pupils pre intervention and for 3 years previous (7b) ☑ Comparison group: assessed levels of primary pupils pre intervention and for 3 years previous (7d) Timeframe: February / March 2014 and rolling Sample Size – Min 30 ☑ Intervention group: expected levels and point scores at end of Year 6 and 7 (without intervention) (7f) ☑ Comparison group: expected levels and point scores at end of Year 6 and 7 (as above) (7g) Timeframe: February / March 2014 and rolling Sample Size – Min 30 ☑ Trend data: assessed levels of pupils for the 3previous year groups (7h) Timeframe: February / March 2014 and rolling Sample Size – Min 30	☑ Intervention group: assessed levels of pupils at end of Year 6 and end of Year 7[vii] post Y1 and Y2 of intervention (7c) ☑ Comparison group: assessed levels of pupils at end of Year 6 and end of Year 7 post Y1 and Y2 of intervention (7e) A sample of Year 7 assessments should be independently moderated These will be moderated by school to school moderation Timeframe: At the end of each academic year Sample Size – Min 30

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
	☑ Heightened long term ambition (8)	☑ Increased number of pupils going into Russell Group facilitating subjects[viii] (KS5 , H/FE) (8a) This information will be gathered along with the data collected from section 6.	☑ Intervention group: pre intervention survey of likely subject choices (8b) ☑ Comparison group: pre intervention survey of likely subject choices (8d) See previous information on comparison groups. Timeframe: February / March 2014 and rolling Sample Size – Min 30 ☑ Trend data: numbers of pupils going into Russell Group subjects (KS5 and degree level) for the 3 previous year groups (8f) Timeframe: February / March 2014 and rolling Sample Size – Min 30	☑ Intervention group: numbers of pupils going into Russell Group subjects in further education (KS5 and degree level) after Y1 and Y2 of intervention (8c) ☑ Comparison group: numbers of pupils going into Russell Group subjects in further education (KS5 and degree level) after Y1 and Y2 of intervention (8e) See previous information on comparison groups. Timeframe: Start of new academic years Sample Size – Min 30

	Outcomes	Indicators	Baseline data collection[i]	Impact data collection[ii]
School system outcomes	☑ Teachers/ schools **involved in intervention** making greater use of networks, other schools and colleagues to improve subject knowledge and teaching practice (9)	☑ Increased attendance at network meetings, conferences etc. (9a)	☑ Numbers and profile of teachers attending numbers of network meetings, conferences, taking advanced courses etc. over 12 months previous to the intervention (9b) Information gained from pre-intervention surveys Timeframe: February / March 2014 and rolling Sample Size - Min 30	☑ Numbers and profile of teachers attending numbers of network meetings, conferences etc. over Y1 and Y2 of the intervention (9c) Gained from surveys at strategic times Timeframe: Gathered throughout the programme Sample Size – Min 30
		☑ Increased participation in 'online' subject for a/practice networks (9d)	☑ Range and scope of online for a pre intervention (9e) Timeframe: February / March 2014 and rolling Sample Size – NULL This will be a nil return as we don't have any resources at present online	☑ Level of support for online networks/hits etc. (9f)
		☑ Increased numbers of schools opting in to participate in networks i.e. attending regular meetings, sessions or events (9g) This will be reported via the VLE system that is being set up (VLE?)	☑ Number of schools actively involved in working together pre intervention (9h) Gained from the heads of the local hubs in a pre-intervention survey Timeframe: February / March 2014 and rolling Sample Size - Min 30	☑ Number of schools actively involved in working together after Y1 and Y2 of intervention (9i) Gained from the heads at the end of each academic year Timeframe: Gathered at the end of each academic year Sample Size – Min 30

[i] **Baseline data** should be captured just before engagement with the programme intervention. Programmes may therefore simply require one round of baseline data collection at the beginning of the programme. However, where the programme implements a staggered engagement of groups, a baseline will need to be conducted for each group just before they engage with the intervention.
[ii] **Impact data** should be analysed after Y1 and Y2 of the intervention as a minimum.
[iii] **Independent reviewers/ moderators** of resources, teacher tests and observations and pupil attainment should be agreed with the GLA.
[iv] **Observations** could be conducted using a peer-to-peer approach or by external evaluators (may be 'subject leads'). If a peer-to-peer approach was taken it would be preferred if an external evaluator moderated a sample and that peer observations were conducted between different schools (i.e. teachers from one school observe a different school) rather than by colleagues from the same school.
[v] **Comparison groups** could be a randomised control group (preferred if possible), such as a cluster randomisation, or a matched comparison group. It should be the same size as the intervention group and should measure all outcomes in the same way. Please see the Glossary for additional explanation of comparison groups.
[vi] **Trend data** is designed to show results of the intervention groups in the context of year on year fluctuation in attainment of different year groups. Trend data should be collected for the 3 previous year groups for the 3 years previous to the age of the intervention group as well as the 2 years when the cohort was the same age as the intervention group. I.e. of the programme is looking at year 6 and 7 starting with year 6s in year 1 then trend data should be collected for the current year 7, 8 and 9 for the years when they were in year 3, 4, 5, 6 and 7. This can then be compared to intervention and comparison group data which will also be collected for 3 years previous to the intervention (years 3-5) as well as the intervention (years 6-7).
[vii] **Attrition** (of pupils) must be closely monitored for programmes addressing transition. If a transition programme monitors a cohort from beginning Y6 to end Y7 and some of the cohort leave the intervention group at end Y6 (due to secondary schools not being involved in the programme), these pupils cannot be replaced by new pupils joining Y7 from a primary school not involved in the intervention. Only pupils who have been engaged with the intervention throughout the programme should be analysed.
[viii] **Russell Group subjects** include: Mathematics and Further Maths , English, Physics, Biology, Chemistry, Geography, History and Languages (Classical and Modern)