Aspire to STEM Independent Evaluation

October 2017 – March 2020

Written by Skyblue Research Ltd

SKYBLUE
RESEARCH & EVALUATION

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Acknowledgements

Skyblue Research would like to thank Ben Dunn, Erin Gray and Wayne Jarvis of STEM Learning for their support and co-operation with this evaluation. We would also like to thank the individuals at seven participating Aspire to STEM (AtS) schools and 6 AtS Educational Leads for completing depth interviews with the research team at a time when the Government was just about to close all schools. Without their insights this evaluation would have been more limited, so we are extremely grateful for their contributions.

Executive summary

1. Rationale for Aspire to STEM (AtS)

Aspire to STEM (AtS) is a complex whole-school intervention aimed at improving primary and secondary school pupil outcomes in subjects related to Science, Technology, Engineering and Mathematics (STEM). It has been implemented with a £1 million investment as a part of the Teaching and Leadership Innovation Fund (TLIF), a 3-year initiative in England to support high-quality professional development for teachers and school leaders[1]. The Programme's aims have been to:

1. Improve leadership to support the teaching of STEM subjects.
2. Develop teacher pedagogy within STEM subjects to support disadvantaged students.
3. Strengthen careers information and guidance (particularly technical pathways).
4. Highlight the vast resources available to help support teaching and promote careers in STEM.
5. Increase Science capital within disadvantaged communities.
6. Encourage enrichment activities in schools for students, their families and the community to raise awareness of STEM careers.

2. Programme scope

The Programme started in October 2017 and finished in March 2020. It has supported 206 schools across 40 Delivery Partnerships located either in 12 areas designated as Opportunity Areas (OAs) or in Local Authority Districts (LADs) which are rated lowest in England (identified as LADs 5 or 6).

3. The Programme's offer to schools

AtS used a model where clusters of between 3-10 schools in the same geographical area shared resources and support to form a Delivery Partnership, in order to build a sustainable 'community of practice' in STEM, adapted to their local needs and context. Each Partnership received funding(£25,000) for bespoke Continuing Professional Development (CPD) for teachers and leaders; career guidance for students; access to STEM inspiration and enrichment activities delivered by a network of STEM Ambassador volunteers; and access to online resources via the STEM Learning 'STEM Club infrastructure and eLibrary'. Each school and Partnership was able to access the support and expertise of a dedicated Aspire to STEM Educational Lead to support needs analysis, action planning and help to access appropriate solutions and resources.

4. Programme outputs[2]

- 206 schools (92 primary and 113 secondary or middle deemed secondary schools, 1 all-through school) were recruited to the Programme across 40 Delivery Partnerships.
- 2,802[3] teachers were recruited, significantly exceeding its target of 880.
- A total of 2,852 CPD events and community events have been delivered
- 3,563 unique participants have attended one or more of the 2,852 CPD activities run: cumulatively accounting for 10,923 participants ('incidences of activity').
- A minimum of 9,000 CPD hours was delivered across all Partnerships.

[2] Please see main report and Appendix 4 for more detailed information about these outputs.
[3] These are the total number of individuals for which AtS holds all the teacher data required by DfE therefore count towards the Participant Recruitment KPI.

5. Programme intermediary outcomes

Using an outcomes framework applied during the Programme's school action planning process[4], and based on a review of agreed data for 29 schools that have participated in the Programme, the researchers found that:

- 184 outcomes could be observed across the sample, an average of 6 outcomes per school. For primary schools, the average was 8 outcomes per school, while for secondary schools the average number of outcomes was 5.
- Schools recruited earlier in the Programme ('cohort 1') had more observed outcomes than those recruited later in the Programme ('cohort 2').
- Outcomes for teachers and pupils were most prevalent (in primary and secondary schools) accounting for 28% each of all 184 outcomes that were classified; followed by outcomes for colleagues / school (20%), leaders (17%) and 7% for 'wider communities' (including other feeder / local schools).
- Primary schools were more likely to report outcomes for each audience.
- Schools each engaged with the Programme differently and this is measured by CPD Units. 1 unit equates to 5 hours of CPD or learning. Analysis found that schools gaining less than 10 CPD units gained on average 6 outcomes, schools receiving between 10-20 units averaged 4 outcomes, while those that received more than 20 CPD units gained an average of 8 outcomes per school.

6. Outcomes for teachers

Feedback gathered from over 1,300 teachers[5] at 122 AtS CPD events finds extremely high levels of satisfaction with the CPD and its quality provided by STEM Learning:

- Overall satisfaction (31% excellent, 38% very good, 30% food).
- CPD quality (69% very good, 30% good) with 76% of middle leaders rating it very good.
- Well organised and planned (100% agreement).
- Relevant and useful (100% agreement).
- Improved subject knowledge and skills (98%) and learning outcomes met (100%).
- CPD will impact future practice (99%) and students they teach (99%).
- Intention to share learning with others (99%).

Participants were asked why they found their CPD useful. Over a thousand comments were codified into 25 core reasons (please see main report). The most common feedback was around how the CPD was practical, not only in its delivery, but also in how the learning could be applied practically back in the school environment. The least referenced aspect was around knowledge about STEM careers, instead the feedback was largely about pedagogy, improving teaching practice, being made aware of inexpensive resources to use and sharing ideas about how to improve pupil outcomes. Whilst there were some convergent themes across all roles, the comments revealed slightly different reasons as to why the CPD was useful for specific roles suggesting that AtS has managed to provide customised, relevant and valued CPD experiences for a range of teaching staff in the targeted schools.

Feedback was most positive when teachers had been highly interactive during the CPD sessions, doing experiments themselves and empathising much more with the experience that their pupils might have when doing similar experiments in school. The CPD appears, for some, to have challenged pre-existing ideas about how Science, in particular should be

[4] This framework was derived by the Science Learning Network and identified 25 possible outcomes from STEM interventions sub-divided by four audiences: teachers, leaders, colleagues/school and pupils.
[5] The sample ranges from 1,366 and 1,516 teachers providing survey responses.

done, with some commenting on being more open to letting the children lead, have more freedom and make better use of the outdoors environment in future.

The most prevalent outcomes for teachers were increased pedagogical knowledge, skills and understanding of STEM subject / curriculum / assessment / practical work / literacy / numeracy, use of new subject and pedagogy knowledge, skills and understanding; the use of the application of this in their teaching; and improved enthusiasm and confidence.

While nationally staff CPD budgets have fallen, and priority given to English and Mathematics, this Programme has stood out for its significant support for this wider set of STEM subjects and teachers. Highly praised CPD has supported pedagogical learning and raised confidence, and the evaluation has shown that when the school provides a supportive environment (such as supportive line managers and SLT have been able to then apply AtS learning in lessons.

7 Outcomes for students

The evaluation has not reviewed any direct feedback from students, but a sample of teachers interviewed for this review described students at all levels as more engaged and progressing better than they were previously as a result of experiencing a refreshed approach to delivering the STEM curricula. Whether meeting their age-related expectations, or improving their performance in mock examinations, the early results of the Aspire to STEM intervention were emerging. Teachers, using differentiated learning approaches, have described feeling better equipped to support, stretch and challenge students who had not been fulfilling their potential.

> *"Children who usually need more encouragement in Science lessons were more involved in the Science work. Children enjoy learning the scientific vocabulary and are able to use it with more confidence." Parklea Primary School*

The most prevalent outcomes for students improved progress in STEM subject knowledge, skills and / or understanding, and their confidence, motivation and engagement in lessons.

Community events, open to all, or targeting disadvantaged students and families have been consistently warmly received (please see case studies in main report). Exciting enrichment events and activities have prompted increased curiosity by student which have continued into the classroom and at home.

In areas where there may be few working STEM role models, encounters with STEM ambassadors are bringing the world of work to the attention of young minds in an accessible way. Educational Leads observe that there is much more though that can be done to help schools more strategically access these kinds of resource to better effect in future.

8 Outcomes for leaders

The main outcomes for leaders were feeling better equipped to understand and then develop STEM curricula to engage and inspire students, coupled with knowledge, skills and use of new leadership and management skills.

With the aim to support the teaching of STEM subjects, leaders received a combination of bespoke support from the Educational Lead, and customised CPD. As a result, leaders were able to draw on new ideas for delivering the STEM curriculum, and benefit from renewed focus on the content and changes in the curricula. Responding to, and preparing for, Ofsted were key drivers (although 'STEM' is rarely mentioned in inspection reports directly), and

critique within inspections and / or changes in senior personnel took schools in different directions during the Programme that may yet affect the extent to which AtS can be expected to provide sustainable leadership outcomes beyond the funded period.

Some leaders reported improved planning, links with feeder schools, and the start of a refreshed culture of learning, reflection and improvement within STEM departments. This has had a stabilising effect on some departments struggling with high staff turnover.

While leaders and staff are now better able to reference and weave in careers context into their teaching, STEM careers education remains, in general, at an early stage of development in schools (particularly at primary level).

9. Outcomes for colleagues, school and wider community

The main outcomes within a whole school context have been an improved quality of teaching and improved sharing of effective practice and resources in STEM subjects. Larger departments appear to have particularly benefited from the intervention. However, outcomes have not been limited to participating departments, rather shared across STEM subjects in a secondary school, and in primary schools, across staff teams through inset days.

The Programme has also been valuable as part of a wider drive to raise the profile of STEM in some schools, while enrichment events have made STEM visible to current and future parents, students and staff and students at feeder schools. Whether supporting whole school priorities (such as raising staff confidence, or improved assessment) or informing the work of the wider school improvement plan (one primary school for example was taking the different lines of enquiry approach and implementing it across the school).

Communities of schools have been encouraged to form, taking knowledge sharing to a more strategic level, and the most effective of these are evolving into ENTHUSE partnerships.

10. Progress against Programme aims

An assessment of progress against each of the 6 aims is provided in the main report and is the focus of the study's conclusion. The key findings are that:

The strongest intermediary outcomes relate to the way in which the Programme has **developed teacher pedagogy within STEM subjects**. The extent to which disadvantaged students have especially benefited is as yet undetermined until academic outcomes are analysed in 2020/21, however, there are examples where teacher have used AtS learning to be more empathetic, targeted and differentiated in their approach to student's individual pathway and progress.

The schools targeted by the Programme are characterised by high levels of multiple disadvantage and social mobility challenges. Insights from this review suggest that previously quiet or disengaged students are shifting their attitude towards STEM, and some students are learning new skills, language and importantly, being given space to explore ideas. Teachers are responding to the practical, real life aspects of the CPD, and are drawing on this inspiration to re-enthuse both themselves and their students.

It was observed that the plethora of support directed to under-performing schools in Opportunity Areas risk cancelling each other out as schools can struggle with too many 'top priorities'. Disadvantage, using the Pupil Premium metric, is not confined to these areas, and there is an assertion that directing future support to more stable schools with high proportions of pupil premium pupils would amplify the outcomes for teachers and students.

There is also emerging evidence that AtS has contributed to **improved leadership to support the teaching of STEM subjects**. The codifying of over 1,000 comments from teachers about the usefulness of their CPD contained a range of reasons pertaining to this ambition including the way in which thought processes and discussion with peers had enabled a better quality of thinking about subject leadership; greater knowledge of leadership strategies; ideas on improving engagement and planning for impact; helping to understand how to set clear targets; and importantly, how to make effective cross-curricula connections (Maths / Science / English / literacy / numeracy / History / Geography); and planning / effective approaches to CPD across the department / school including knowledge about how to support NQTs and non-specialists (please see main report '25 reasons the CPD was felt to be useful).

Strengthening STEM careers information and guidance in schools is a long term, generational undertaking and it is perhaps not surprising that outcomes linked to this Programme aim are less prevalent and overt than pedagogical pursuits in schools. However, this Programme has raised awareness of its importance, and relevance across key stages, and enabled some teachers in schools that feel ready to enrich their delivery with references that encourage students to think outside the classroom. A survey of 1,400 teachers receiving CPD found that 24% found the online resources at www.stem.org.uk very useful, with a further 15% finding them quite useful, 5% finding them of little / no use, but the vast majority (56%) hadn't used these resources. This suggests that there is more to do to connect participants with this wider set of tools over time.

The extent to which teachers across the participating schools feel more confidence to give STEM guidance (particularly technical pathways) is probably better assessed through a more direct survey approach rather than speculate or generalise from the sample of 'school journeys' reviewed in this evaluation.

The evaluation also finds that two of the Programme's aims have largely been conflated by schools when thinking about what they wanted to achieve and prioritise, and the realities of their capacity to embrace the opportunities presented by AtS. These aims relate to **increasing Science capital within disadvantaged communities** and the **encouragement of enrichment activities in schools for students, their families and the community to raise awareness of STEM careers.**

The starting point or baseline for Science capital in these communities is not known. However, this Programme has been a positive contributing factor to raising, in the short term at least, awareness and interest in STEM and its real-world applications through community events. There is an appetite to further develop and sustain this strand of activity by schools that have experienced it, and /or already have a strength or whole school improvement priority to engage with their community and raise aspirations through enrichment.

The desire to access STEM Ambassadors featured in the majority of the Delivery Plans, but uptake appears to have been less than might potentially have happened, similarly, the case studies in this review do not reveal much development in schools or leaders improving employer engagement as a result – *noting that this review is for a sample of schools only and there may well be examples of this amongst schools not included in this study*.

11. Attributing outcomes to the Programme

Overall, outcomes have varied in participating schools. Variables affecting STEM progress are many and complex. 14 contributing factors / pre-conditions that are more likely to lead to broader, sustained STEM outcomes in schools have been identified and a range of school characteristics (such as their size, their Ofsted rating before and since the Programme commenced and the CPD units achieved) considered to help understand non-uniformity of outcomes observed. Deeper analytical work is expected to be included in the final independent impact evaluation by EEF and RAND in 2020/21, however, in anticipation of that work, this study finds that:

- A change in Ofsted inspection ratings per se are of limited value to identifying attributable changes in STEM performance. However, if these were combined with a process whereby all participating schools were to complete their pre- and post-AtS Programme subject performance criteria ratings assessment (as Haydock High School has done for this review) then the data could help develop more revealing correlations between the AtS intervention and wider school improvement context.
- Schools that were and remain in special measures struggle to optimise a Programme such as AtS, if the conditions in school are so disruptive that teachers cannot fully apply their CPD in classrooms because they spend time instead managing pupil behaviours.
- Teacher and leader staff stability or turnover appears to be a particular enabler or blocker for the Programme to be effective, successful and embedded.
- New leaders of STEM subject leaders with a personal desire to drive up standards and significantly improve STEM outcomes and create cross-curricula connections in school can be a driving force for change, and AtS can be a helpful addition to their toolkit to make STEM more engaging, inspiring and accessible in their schools.
- The support and engagement of leaders appears to be a key success factor, along with the Programme's flexibility to respond to emerging needs (reflecting the fact that in schools requiring multiple interventions to improve, planning horizons are at best 1 to 1.5 terms ahead).
- Schools that have taken up more CPD, in general (and with exceptions) are reporting greater numbers of outcomes. Also important is the school's starting level of maturity across a number of measurable domains (see main report for explanation).

12. The added value of the Programme

A review of teacher feedback following their CPD encounter(s) suggest that the Programme has added value for some of them, either because it was the only STEM CPD they had received, or because it differed from other CPD they had experienced before. The way in which the CPD provided practical examples was especially appreciated. For other teachers, it was the way in which the AtS CPD aligned to the National Curriculum, but in a more compelling or practical way. Various novel elements were identified too from taking part in the CPD including a flow of new ideas for the department and new strategies to try. The CPD, for some, provided an opportunity to see STEM from other people's viewpoints (including their students), challenging their own practice and ways of teaching the subject(s).

A review of school journeys found a number of areas reported by their key contacts and Educational Leads as having added value within the context of their whole school improvement plan too including:

- The encouragement of greater levels of STEM collaboration with local schools than might otherwise have happened.
- The acceleration of inspirational community activity.

- New or recent STEM subject leads in particular appearing to get a boost from the AtS support to help them have the confidence and tools to improve the profile – especially of Science – in their school.
- In some cases, the subject lead has created a new direction for the subject and achieved greater levels of SLT and peer support across the school.
- Cross-curricular connections have been made by some teachers, including specialists and non-specialists so that a STEM subject does not sit in isolation.
- The Programme has afforded some novel investment in activities not tried before such as STEM community events and enrichment (typically Science-related shows - that has inspired children and their families alike); and / or deeper CPD such as a 3 day residential for members of staff never afforded before.
- STEM Leaders enjoy improved connections with neighbouring schools often with little or no legacy of working together prior to the Programme, and teachers' professional networks have expanded at all levels.

13. Counterfactual

Without the Programme's support, it was considered that much of the CPD would not have taken place. The Programme has, in some of the schools that have been reviewed, catalysed new approaches, relationships, 'reach' (i.e. teachers trained) and cross-department and intra-school collaborations.

Seven schools studied in detail for this review affirmed strongly, that without this Programme, the CPD delivered would most likely not have happened at all, or to a much-reduced extent in the same timeframe, and to far fewer staff members.

> *"The project has helped us to achieve outcomes more quickly and more effectively than would have happened if we had not engaged."*

One of the seven schools, rated good by Ofsted, noted that there has been added value to taking part in AtS, building on, rather than duplicating what was already taking place.

> *"We'd still have trained, but not to the same extent, or in the same way with other schools."*

The funding has been a decisive factor, opening up opportunities that would have been unlikely to have been taken up otherwise. The funding has made a real difference to being able to offer bespoke and appropriate training. The requirement that spending was only for CPD, rather than other items like equipment also increased the take up.

14. Concluding Remark

Taken together the sampled evidence included in this review suggests that participants in schools have found the Aspire to STEM Programme to have been of high quality, relevant, useful, customised to their needs, helpful to improve their practice and leadership and has added value in ways that would not have otherwise happened at all or to the same extent in the same time period.

In short, it has been a catalyst for schools that are relatively immature in their STEM journey and an accelerant for those schools that have more mature STEM assets on which to build. Intermediary outcomes have emerged that have the potential to impact on student progress, attainment and teacher retention and this will be the subject of the final assessment in 2020/21. In the meantime, there is opportunity to learn many lessons from the Programme's processes to better understand the non-uniformity of outcomes illuminated in this study.

1 Introduction

Aspire to STEM (AtS) is a complex whole-school intervention aimed at improving primary and secondary school pupil outcomes in subjects related to Science, Technology, Engineering and Mathematics (STEM). It has been implemented as a part of the Teaching and Leadership Innovation Fund (TLIF), a 3-year initiative in England to support high-quality professional development for teachers and school leaders[1].

The Programme has seen STEM Learning support 40 partnerships of schools located either in 12 areas designated as Opportunity Areas (OAs) or in Local Authority Districts (LADs) which are rated lowest in England (identified as LADs 5 or 6). A number of schools in the eligible areas did not have an Ofsted rating at the time of recruitment, because the previous school was closed and became an academy, and these schools were eligible as well.

The Programme commenced in 2017 and has recently completed its funded delivery period on the 31st of March 2020. It had six high level aims:

7. Improve leadership to support the teaching of STEM subjects.
8. Develop teacher pedagogy within STEM subjects to support disadvantaged students.
9. Strengthen careers information and guidance (particularly technical pathways).
10. Highlight the vast resources available to help support teaching and promote careers in STEM.
11. Increase Science capital within disadvantaged communities.
12. Encourage enrichment activities in schools for students, their families and the community to raise awareness of STEM careers.

Inputs

There has been investment of £1 million to deliver this Programme which has afforded each of the 40 Delivery Partnerships an approximate 2-year support package with access to £25,000 of support. The amount was allocated by schools collectively, primarily to cover the costs of Continuing Professional Development (CPD) as well as the costs of expert staff employed by STEM Learning, including Educational Leads (an education expert), who provided agreed support to each school and Partnership. This could include needs analysis and action planning with a school and then support to help the Partnership plan and implement the required activities. Each Partnership had a dedicated Educational Lead, who in turn had access to a number of support and assistance services.

Activities

STEM Learning managed all recruitment, solution design and delivery processes required for the Programme. To ensure the feasibility of intervention roll-out, schools were recruited in two cohorts[2]. This would mean complying with the TILF eligibility criteria. All schools were therefore located in LADs 5 or 6 or Opportunity Areas.

AtS used a model where clusters of between 3-10 schools in the same geographical area shared resources and support to form a Partnership, in order to build a sustainable ‘community of practice’ in STEM, adapted to their local needs and context. As part of this intervention, each cluster of schools received funding (£25,000) for bespoke (CPD) for teachers and leaders; career guidance for students; access to STEM inspiration and enrichment activities delivered by a network of STEM Ambassador volunteers; and access to online resources via the STEM Learning ‘STEM Club infrastructure and eLibrary’.

Participating schools were offered a variety of face-to-face and online CPD activities, complemented by teaching resources identified by the schools with the support of Educational Leads. Bespoke CPD for STEM teachers focused on subject knowledge and pedagogy across Mathematics, Physics, Chemistry, Design and Technology and Computer Science whilst CPD for leaders focused on identifying best practice and management of STEM subject areas and leadership skills of subject leads.

Careers guidance and information was provided for teachers and leaders to enable them to bring real-life STEM career contexts in to the classroom. There were STEM Insight placements for teachers / career leads with the ambition to help schools meet the needs of the Gatsby Career benchmarks[3].

Additionally, the Programme targeted pupil aspirations through focused inspiration and enrichment activities that sought to raise awareness of STEM outside the school environment looking at engagement with parents, scout groups and non-school groups to develop community perspective for AtS.

Delivery was implemented by STEM Learning quality assured providers, including the National Stem Learning Centre subject expert team, STEM Learning's Network of Science Learning Partnerships, external educational experts and trusted partner organisations (Maths Hubs, Institute of Physics), as well as 'STEM ambassadors' who are STEM professionals registered and trained by STEM Learning.

Activities were delivered through a mix of online and face to face methods, delivered at various locations, for example, on-site at school or a partnering school, at a Science Learning Partnership or regional centre and at the National STEM Learning Centre in York. Both physical and informational materials were tailored to individual Partnership needs.

Outputs

- 206 schools (45% primary, 55% secondary or middle) were recruited to the AtS Programme across 40 Delivery Partnerships.

- 191 of these schools were described as 'active' by the end of the Programme[4].
- The Programme had a target to recruit 880 and has significantly exceeded this, in fact, 2,802[6] teachers were recruited comprising:
    - 801 participants in Cohort 1 and 2,001 participants in Cohort 2
    - 992 teachers from primary schools (35%)
    - 1,810 teachers from secondary schools (65%)
    - 641 individuals in Senior Leadership Team roles at their schools
    - 869 Science teachers, 595 Mathematics teachers, 265 Technology teachers, 241 Computer Science teachers, 87 Engineering teachers and 745 'other' teachers i.e. not classified as having a STEM subject specialism.

- A total of 2,852 CPD events and community events have been delivered comprising:
    - 1,077 Science CPD events
    - 446 Leadership CPD events
    - 435 Mathematics CPD events
    - 359 Computing Science CPD events
    - 209 Technology CPD events
    - 101 Engineering CPD events
    - 225 'other' CPD events
    - 79 community events.

[6] These are the total number of individuals for which AtS holds all the teacher data required by DfE therefore count towards the Participant Recruitment KPI.

- 3,563 unique participants have attended one or more of the 2,852 CPD activities run; cumulatively accounting for 10,923 participants ('incidences of activity') to date since September 2017. This demonstrates that participants could, and did, attend more than one CPD or community event over the lifetime of the Programme.

- The distribution of the £1 million funding was equal (£25,000) for each of the 40 Delivery Partnerships.

- Data from the central booking system finds that 176 individual schools completed 1,787 CPD units of activity equivalent to 8,935 hours of learning between October 2017 and March 2020 but this is likely to be an under-estimate[5].

- Analysis of Programme engagement data shows that 54% of all CPD was related to Science compared with 4% for Physics, 7% in Computing Science and 3% in Mathematics and Design Technology respectively.[6]

- In total, 66% of the CPD was delivered to secondary / middle schools and 34% was delivered to primary schools.

Ofsted ratings for targeted schools

- 107 (56%) of the 191 active schools were rated 'requires improvement' or 'inadequate' prior to their engagement with the Programme[7] and of these 107 schools, 67 have had an inspection since AtS engagement. 39 (58%) of these have improved their Ofsted rating.

Intended Outcomes

The Education Endowment Foundation has commissioned RAND Europe to complete an independent evaluation of the Aspire to STEM Programme which will provide an assessment of the Programme's efficacy in 2021. As it notes in its 8th February 2019 Study Plan, the AtS intervention is designed to lead to improvements at three levels in the schools:

Leaders	improved leadership, new relationships with STEM employers, better engagement with parents, families and the community
Teachers	increased confidence, motivation and competence in teaching STEM, better knowledge and ability to use real-life and industry contexts, improved teacher retention
Students	raised aspirations and ultimately, improved STEM outcomes

The assessment will consider the extent to which these outcomes have been affected by AtS for the 206 intervention schools.

Primary schools	Pupil attainment in STEM: - Key Stage 2 (KS2) attainment in Mathematics - KS4 attainment in Mathematics and STEM subjects
Secondary schools	Pupil progression: - KS5 enrolment in Mathematics and STEM Teacher attrition: - Teacher leaving the school (turnover) - Teacher leaving the profession (wastage)

Time needs to elapse beyond the end of the AtS Programme (31st March 2020) in order that RAND Europe can look at school performance data to investigate the possible contribution made by the Programme to pupil outcomes. School workforce data will also be used for their assessment. Please see appendix 1 for the Study Plan Logic Model.

Aspire to STEM Programme rationale

Aspire to STEM tackles low pupil aspiration through improved STEM teaching. The intervention team believe that improved STEM teaching more than anything else can improve pupil opportunity and drive social mobility. Via improved STEM teaching, leadership and community engagement, the intervention aims to raise aspirations and career awareness among students, and ultimately improve student STEM academic outcomes.

2 Methodology

Prior to RAND Europe's scheduled 2021 impact assessment, STEM Learning and DfE were keen to explore whether at the end of the Programme in March 2020, there have been any emergent **intermediary outcomes** that enable them to consider the relative success of the Programme. Consequently, Skyblue Research Ltd was commissioned on the 4th of March 2020 to undertake a rapid review of available Programme data and insights to identify the typology of outcomes that the Programme has been contributing to in participating schools. Given the requirement for an evaluation report to be available within a 6-week turnaround period a pragmatic mixed methods approach was agreed using the following data and methodologies.

Secondary Data Review

Ofsted inspection reports

At the end of the AtS Programme 191 of 206 recruited schools were defined as 'active' participants. STEM Learning provided data noting each school's Ofsted inspection ratings before their engagement with AtS and was interested to compare movement in these ratings since that time.

Skyblue identified 82 schools that had received an inspection since engaging with AtS; and of these 39 received their inspection at least 1 year after engaging with the Programme. The latest inspection reports for these 39 schools were reviewed to identify any references to STEM using agreed keyword search terms and to help determine a methodology for sampling 6 schools for more detailed case analysis.

The six schools selected reflected different rating movements and a diversity of school and Opportunity Area contexts (please see appendix 3 for a detailed note about the sampling approach and keyword searches used for this aspect of the methodology). Each school's pre- and since-AtS engagement inspection reports were reviewed in their entirety to identify any observations made by inspectors about STEM change within the schools, and to get a clearer picture of the likely contributors to such changes if observed at all.

School self-reported case studies

At the end of February 2020, a total of twenty schools had elected to complete a voluntary case study describing an example and / or highlight of their AtS engagement activity using a template and guidance supplied by STEM Learning. These case studies included self-reported outcomes. This was a self-selecting sample of schools.

School Action Plans

For each of the same 20 schools who provided a written case study, STEM Learning provided documentation to better understand their AtS 'journey' including their needs analysis and action plan. This plan was typically completed by school representatives with an Aspire to STEM Educational Lead at the start of their engagement with the Programme to help identify STEM priorities in their school development plan for that year, assess STEM strengths and areas they might be able to improve with the support of the Programme.

Ultimately 15 action plans were available for review by Skyblue. Each of these schools usefully completed a self-assessment of Science, Design and Technology, Mathematics, Computer Science and Engineering against 4 performance criteria as well as a comparison to non-STEM subjects at that time providing insights about the likely focus of intervention that might best meet needs over the Programme's lifetime.

Whilst this exercise has some value, it could have greater value still if data for all participating schools were analysed, particularly after they have completed their assessment of what the performance is like for each STEM subject now the Programme has ended. One school that had completed this baseline and post-AtS engagement assessment revealed illuminating shifts that might be more compelling if applied to the whole sample (please see 'Attribution' chapter 8 in this report).

Delivery Partnership Plans

For the 20 schools that supplied self-written case studies, STEM Learning provided Skyblue with that school's corresponding Delivery Partnership Plan which helps contextualise that school's situation in relation to their local cluster of schools.

Engagement Data

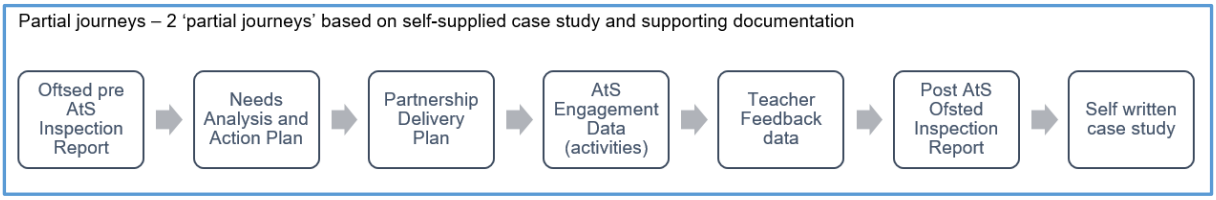
STEM Learning supplied data about the different activities that schools engaged with since 1st October 2017 until 31st March 2020. This data captured STEM Learning delivered CPD i.e. national/residential CPD in York and through the Centre's network partnerships across England. This CPD was all completed via a central booking system. Any CPD organised locally rather than via the central booking system was not included so this means the true level of engagement will be greater than the amount summarised in this report. For example, some bespoke sessions delivered at each school locality may not have been included; similarly the Programme Manager explained that a small amount of third-party delivered CPD, as well as coaching/mentoring/consultancy delivered by the Educational Lead will not have been included in the engagement data supplied for review.

CPD Feedback from Teachers

Teachers in receipt of AtS CPD support have completed feedback about their experience enabling an aggregate view of their satisfaction with the AtS Programme as well as CPD quality, value to their teaching skills and future practice. This data includes feedback about the usefulness of AtS courses and STEM Learning courses delivered at Delivery Partnership school locations. Sampled data from 1,517 respondents across 122 different AtS CPD, training, learning and networking activities was reviewed.

Document Triangulation

For two of the twenty schools that supplied self-written case studies, all available secondary documentation was reviewed in order to compile a 'journey' that sought to establish any links between the AtS Programme inputs, activities, outputs and outcomes within the context of any changes noted by Ofsted inspectors since engaging in the Programme. We called these 'partial journeys'. They drew on documentation as illustrated below.



Primary Research

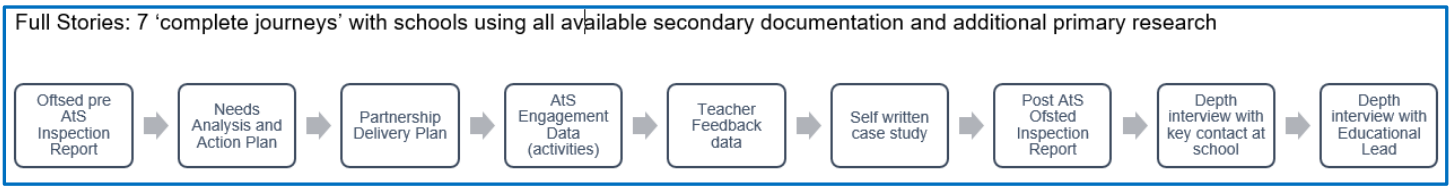
STEM Learning was invited to select up to 10 schools from those supplying self-written case studies[8] that would be approached for interview by Skyblue in March to explore:

- Their schools' motivations for getting involved in the AtS Programme.
- The value they attached to the needs analysis and action planning process.
- What changes, if any, there had been for leaders, teacher, 'whole school' and pupils and any thoughts about the contribution AtS has made compared to other factors.

An interview script was designed and improved with the support of STEM Learning and Educational Lead for the Programme; with due reference to the EEF / RAND Europe Study Plan and STEM Learning impact documentation[9]. The script also incorporated a maturity model enabling the interviewee – a key contact identified in the school for the AtS Programme – to reflect whether STEM had changed in the context of whole school development over the past 2 years. Schools were asked to consider where their AtS journey began and, with the Programme's support, where it concluded using this 5-point scale.[10]

Level of STEM maturity	**1. Beginning** *Principle accepted and commitment to action*	**2. Early progress** *Early progress in development*	**3. Results** *Initial achievements evidence*	**4. Maturity** *Results consistently achieved*	**5. Exemplar** *Other schools learning from our consistent achievements*
Quality of subject leadership					
Collaboration with other schools					
Quality of STEM teaching					
CPD for STEM teachers					
STEM careers education					

Interviews were completed by telephone enabled the researchers to provide a 'complete journey' by triangulating the interview results with all secondary data previously described.



Recruitment and informed consent was managed by STEM Learning prior to Skyblue's follow-up recruitment process. Recruitment commenced on the 5th of March and by 10th of March 3 schools had agreed to an interview. Recruitment continued up to and including the decision by the Government to close all schools owing to COVID-19 on Friday 20th of March. Ultimately, 7 schools were interviewed. It was agreed with STEM Learning that these 7 complete journeys, when considered with the 2 partial journeys and 6 detailed Ofsted report case analyses provided a proportionate base of 15 journeys in total on which to draw for this report (Please see appendix 2 for details of these 15 schools and their key characteristics).

In addition, any data supplied for schools that provided a self-written case study and / or action plan was reviewed in order to extract the optimum amount of insight from the documentation. Furthermore, one cluster of primary schools in Scunthorpe provided a 'Partnership Impact' case study which revealed outcomes for inclusion in the analysis.

In total the researchers have been able to look at 29 schools (15% of the active sample) through this mixed methods approach to observe and classify outcomes emerging from the AtS Programme. 20 of these schools are secondary, 8 are primary and one is a middle school. (Please see appendix 2 for a list of the 29 schools)

Educational Leads

Six Educational Leads[11] were interviewed to provide their observations about the progress made by schools they worked with during the Programme. These schools were the same ones interviewed by the researchers offering opportunity for triangulation of views about the different outcomes that may have emerged.

Evaluation scope and limitations

The focus for this report is to illuminate typologies of intermediate outcomes that have been experienced by a sample of schools that have engaged with the Programme. It is not the intention for these findings to be generalised across the whole sample of 206 engaged schools, nor to attempt to establish the Programme's impact, rather to highlight the nature of outcomes that may have been experienced by stakeholders and to offer an early indication of the progress that may have been made against the Programme aims.

The reliability of the evidence differs with each of the methods that have been selected during this rapid review period, the strongest evidence being interviews with 7 schools and 5 corresponding Educational Leads in March 2020 as the Programme approached closure. These interviews helped enrich understanding of the wider school environment and profile of STEM, in which it was possible to more readily contextualise the AtS intervention. These schools, however, were not selected in any way to be representative or typical of the wider sample. Primary research has been limited to key contacts from these 7 schools, 5 Educational Leads and STEM Learning Programme management personnel. Feedback was not gathered directly from pupils nor members of the community, so outcomes for these audiences relies on reported feedback (perceptions) from teachers only.

The remainder of the assessment is based on secondary data. In selecting schools to focus on the researchers widened the spread from just those that supplied a case study should these be positively skewed. Unique school cases were selected based on their Ofsted rating before and since AtS started. Ultimately, 29 schools were reviewed in detail which is 15% of those still active at the end of the Programme. Variables considered have included:

- What cohort the school belonged to (i.e. how soon they were recruited).
- Whether the school was primary, middle or secondary and their size (pupil numbers).
- Any change in Ofsted inspection ratings prior to and since AtS engagement.
- CPD units completed by the school (a metric that can contribute in future to RAND Europe's impact evaluation when looking at 'dosage' and 'fidelity'[12]).

These 29 schools were located in 15 of the 40 Delivery Partnerships. This report has not been designed to explore outcomes by or between Delivery Partnerships, something that could, however, be worth further investigation.

Finally, this evaluation is not a process evaluation, something STEM Learning is completing soon after this commission has been completed.

3 Context: schools engaging in the AtS Programme

206 schools were recruited to benefit from the AtS Programme, and as previously described, they had to comply with TILF eligibility criteria. All schools were therefore located in LADs 5 or 6 or Opportunity Areas which in 2016-17 were areas "identified as the most challenged when it comes to social mobility by the Department for Education (DfE)[13]. These areas were identified drawing on the Social Mobility Index and the Achieving Excellence Areas Index (DfE, 2017: 1). The Opportunity Areas include 12 locations:

- West Somerset
- Norwich
- Blackpool
- North Yorkshire coast
- Derby
- Oldham
- Bradford
- Doncaster
- Fenland and East Cambridgeshire
- Hastings
- Ipswich
- Stoke-on-Trent.

LADs rated 5 and 6 by DfE (within 1 to 6 range) are local authority districts with the lowest scores on composite indicators that include measures of pupil attainment, such as Progress 8 scores, and "capacity to improve indicators" identified by DfE, such as the number of teacher trainees per 10,000 pupils (DfE, 2016: 10-11).

The Programme commenced in September 2017, and all recruitment of schools was completed by September 2018, by which time a total of 92 primary, 113 secondary or middle deemed secondary schools and 1 all-through school had been engaged.

Ofsted Ratings

The following analysis relates only to the 191 'active' schools engaged in the Programme as at March 2020.

Table 1: Changes in Ofsted inspection ratings for AtS targeted schools

Rating	Number of schools	Number that have had an inspection report since AtS	Number of schools with pre- and since AtS reports that have improved
4 – inadequate	23	12	11
3 – requires improvement	84	55	28
2 – good	61	15	0
1 – outstanding	1	0	-
New school	22	-	-
Total	191	82	39

Of 82 schools that had received an Ofsted inspection report since they commenced the AtS Programme 39 (48%) had improved their rating, 38 (46%) retained the same rating as their previous inspection and 5 (6%) received a lower inspection rating[14]. This means that just under 1 in 2 schools engaged by the Programme for which it is possible to currently review, have been on a wider journey of school effectiveness and improvement. The extent to which this wider landscape provides conditions for Programmes like AtS to thrive and / or the extent to which AtS contributes to that wider success will likely be a key line of inquiry for the RAND Europe impact assessment.

The researchers agreed with STEM Learning that there might be benefit in reviewing some of the 82 inspection reports that had been completed with schools in case there were any direct or indirect references to changes in STEM at these schools since the intervention started. Given that it is expected that time must elapse for intermediary outcomes to emerge from the Programme, focus was given to 39 schools who received an inspection report at least one year after they commenced the Programme. A review of these reports found:

- The most prevalent STEM-related references, if made at all, were to Mathematics, Science and Technology with few references to Computer Science and Engineering (the word STEM was never used in any of the reports).
- There were more observations about quality of teaching, learning and assessment (although the word pedagogy was never used) compared to references to careers awareness or promotion which were limited to secondary schools with a sixth form.
- That all reports assess leadership. Most references are to the head teacher, senior leadership and middle managers and the subject leads for Mathematics and Science.
- Community engagement activity was only commented upon if the inspectors noticed something exemplary, for example, where the head teacher, sometimes newly appointed within schools rated 3 or 4, had consciously sought to develop the school's profile within its local community as part of a wider cultural vision.
- More revealing comments were discovered where a STEM subject had been included in the 'deep dive' element of an Ofsted inspection.
- Pupil outcomes, particularly those of disadvantaged students are a consistent focus of most inspection reports and some reference their performance in Science and Mathematics subjects.
- A golden thread for schools rated 3 or 4, was teachers' lack of challenging pupils in to perform to their potential. Solutions included improving the approach to raising aspirations as well as the better use of assessment.
- Enrichment activity, if mentioned at all, referenced sport and art, although one report, specifically mentioned the benefit of the school having a Science Club. There were no explicit references to the words 'Science capital' so this was especially difficult to identify within this set of documents.

A review of just the most recent inspection reports on their own, however, failed to provide a sufficient context in which to situate any STEM changes, therefore the researchers completed deeper analysis of 6 purposely selected secondary school cases where it was possible to compare reports before and since AtS engagement. These revealed more interesting insights about the school context, changes in the school and STEM which are found in Table X of the chapter entitled 'attribution'. These 6 cases are also presented in a detailed form in a separate 'Journeys' companion document.

STEM subject performance at the start of the AtS Programme

Further context for STEM within AtS target schools is available by looking at the assessments they made about STEM subject performance when completing their needs analysis with their dedicated Educational Lead. Representatives of the school were asked to score each subject 1 (outstanding), 2 (good), 3 (requires improvement) or 4 (inadequate).

The researchers were provided with a sample of 15 action plans, belonging to the majority of schools that supplied a self-written case study to STEM Learning by March 2020.

Table 2: Baseline STEM subject performance ratings by a sample of 15 AtS schools

Performance Criteria	Science	D&T	Maths	Computer Science	Engineering	STEM Mean Score	Non-STEM subjects
Quality of teaching	2.67	2.29	2.20	2.62	2.40	2.43	2.21
Pupil learning	2.93	2.57	2.40	2.85	2.60	2.67	2.36
Quality of subject leading	2.40	2.36	2.13	2.54	2.20	2.33	2.29
STEM careers education	3.00	3.33	3.08	3.08	3.33	3.17	3.00
Subject Mean Score	2.75	2.64	2.45	2.77	2.63	2.65	2.46

Note: a score closer to 1 means the criterion is viewed as outstanding. Closer to 4 means inadequate.

Amongst this sample, the self-assessment process revealed that at the start of their AtS journey the quality of subject leading was seen as the prevailing strength at that time for STEM generally, whilst the quality of teaching was seen as the best performing criterion for non-STEM subjects. Careers education was assessed for STEM and non-STEM as the weakest criterion in their schools and equivalent to a rating of 'requires improvement'.

Table 3: Comparative performance of STEM and non-STEM subjects in AtS schools

Rank	STEM	Non-STEM
1st (best criterion)	Quality of subject leading	Quality of teaching
2nd	Quality of teaching	Quality of subject leading
3rd	Pupil learning	Pupil learning
4th	STEM careers education	STEM careers education

Looking at each of the 5 STEM subjects individually, the strongest performer was Mathematics (2.45), followed by Engineering (2.63), Design and Technology (2.64), Science (2.75) then Computer Science (2.77). Not all subjects were taught in all schools of course but the analysis has been designed to enable like-for-like comparison by those who did rate each subject where it was relevant in their school setting. At aggregate level STEM scored 2.65 which means it could be viewed as being between requires improvement and good (tending to the former descriptor). This score is slightly worse than the rating of 2.47 for no-STEM subjects suggesting a strong rationale for an intervention such as the Aspire to STEM Programme.

STEM needs and challenges in schools at the start of the AtS Programme

A review of the qualitative school journeys and associated Delivery and action plans identified a range of needs and challenges that schools were seeking to address at the outset of the AtS Programme described in the next table.

Table 4: STEM needs and challenges in schools at the start of Aspire to STEM

Leaders
STEM awareness • Limited range of STEM provision • Low profile of STEM • Helping the school be aware of what constitutes best practice in each of the STEM subjects to support the line management of STEM subjects and help understand what to aspire to • Poor Science outcomes. Leadership • In respect of middle leadership training for STEM subject leaders, support with understanding how to bring about rapid improvement and show impact of leadership on outcomes for pupils • Empowering subject leaders • Building capacity – e.g. developing second in command • Preparing for or supporting staff who have taken the 'National Professional Qualification for Middle Leadership' (NPQML) • Insufficient monitoring in teaching and learning • Monitoring of impact, leading to a lack of or unclear accountability • Support with line management – discipline, motivation, being ready to lead • Subject leadership support. STEM teaching • Subject differentiation • Lack of awareness of post 16 career options • Inconsistency of practice • New leaders requiring coaching and support – e.g. with curriculum planning or understanding of leadership • Modernise output and projects for Technology to sustain enthusiasm and link to modern manufacturing in the commercial world • Limited opportunity to learn from peers.
Teachers
Capacity and collaboration • Staff turnover and 'turbulence' • Supply staff means lack of stability, continuity and affects pupil outcomes • Limited opportunity to Managing constant change in staffing • Collaboration between STEM subjects: currently, STEM is seen as a 'Science' responsibility. • The possibility to introduce a STEM qualification in the future • Ensuring all members of staff are knowledgeable and take responsibility for all subjects whether they teach them or not. CPD • Limited opportunity to learn from peers, particularly outside of the school • CPD for NQTs in Science department required. Pedagogy • Quality of subject teaching – 'creating a buzz around Science' • Variability of classroom practice "*There are some excellently qualified teachers in the department, but they are not excellent practitioners."* • Recording and better use of subject specific vocabulary • Support with providing subject specific feedback

- Subject differentiation. Support is needed with pedagogy to improve differentiation at Grades 1-4 and 8-9.
- Increase expectations of pupils / stretch and challenge
- To develop behaviours for learning to support independent learning - in Science, focusing on high prior attaining pupils.
- Ensuring all staff are fully confident with the demands of the new GCSE and assess pupils' progress confidently.
- Strategies to develop transferable Mathematics skills
- Skills gaps – e.g. Technology in GCSE Design and Technology or assessment
- Technology changes to GCSE. Staff were not confident in teaching the new specifications
- Limited palette of teaching styles
- EAL support.

Knowledge and resources

- Subject knowledge (Physics particularly)
- Support with coding and web design
- More knowledge about how to access relevant teaching resources which are current and age appropriate
- Lack of subject specialists
- No Science specialist in Physics and Science teachers in the department were not confident with the increased Mathematics element.

Careers advice and guidance

- Using careers information to broaden the horizons of students
- Lack of confidence to give CEIAG for STEM.

Pupils

- Low aspirations
- Low (albeit unmeasured) Science capital
- Lack of Science literacy
- Ensuring students acquisition of knowledge is improved in STEM
- Poor prior experience leading to disengagement
- Disruptive behaviours
- Developing student leaders within STEM.

Whole school

- Capacity / time constraints
- Staff confidence
- Budget resource limitations
- Recruitment and retention
- Transition from primary school to secondary school
- Improved uptake at GCSE
- A lack of challenge generally for pupils
- A lack of ambition
- Insufficient progress, including progress of pupil premium students
- Same faces accessing trips and opportunities
- Lack of forward planning
- Working scientifically (whole school)
- Embedding the use of STEM in practical settings
- Using Technology in the classroom
- Computing across the curriculum.

Community

- Little or sporadic STEM enrichment, with limited sense of community as a result
- Few employer links (particularly at primary level)
- Lack of parental engagement
- Rurality of some schools limits trips
- No, or poor previous, use of STEM Ambassadors.

Educational Lead Perspectives about STEM in AtS targeted schools

Interviews with 5 Educational Leads in March 2020 enabled them to reflect on the situation in schools that they had provided dedicated support to during the Programme. They described the situations in schools as follows:

- Hard working STEM teams within the schools, grappling with high levels of staff turnover and movement of senior leaders.
- Periods of instability and turbulence in relation to staffing.
- Staff structures that could hamper the ability to attend meetings / engage in activity.
- A lack of capacity to engage with AtS and STEM more generally despite being keen and hungry for the Programme' i.e. STEM wasn't as important as other issues in some schools at the start: *"They were too busy to bother with Science."*
- Supply staff in schools being a transient population that are hard to support (for any intervention not just STEM).
- Changes in personnel during the Programme resulting in a change of STEM activity emphasis. In one area, local authority solutions took priority over the AtS Programme.
- Different decision-making approaches that would affect the school's engagement with STEM activity / external support e.g. accessing and engaging schools in multi-academy Trusts was more of a challenge as they tended to have centralised decision making.
- Schools doing their best to adapt to the new Ofsted framework which was felt to elevate the quality of teaching and enrichment activity in schools[15].
- One Educational Lead suggested the new framework had made it more challenging for STEM staff to access CPD.
- A lack of the strategic use of the STEM Ambassadors network by schools so not making the most of that opportunity in some schools.
- The divergent approaches / buy-in by the head teachers in schools for STEM / any activities within the context of their wider school improvement plan

  "It's like getting a menu, it's hard to know what the issue is initially. You think it's about a) then realise actually we need b) and c). So, the plan was adjusted."

  Disconnection between middle and senior leaders in schools which Educational Leads were able to help address through their support

  "Heads of department, teachers and deputy heads have more in common than they realise or share with one another."

Within this varied context, the Aspire to STEM Programme has sought to provide appropriate support since 2017. The report now goes on to describe the kind of outcomes that the Programme has contributed towards. Firstly, we consider the feedback from over 1,500 teachers that experienced at least one incidence of Aspire to STEM CPD training or support and explore how useful they found the CPD received. Secondly, we consider 7 school case studies to appreciate how the Programme has sought to make a difference in a whole school context. Lastly, we look at outcomes achieved for the different intended audience of the Programme, and then consider to what extent the Programme aims have been met.

4 Teacher feedback

Feedback from teachers was gained after 122 AtS CPD, training, networking and learning interventions during the Programme's lifetime. Participants comprised a range of school staff during the intervention period. Monitoring data available for c80% of those providing survey feedback suggests a participant profile comprising teachers who self-classified as follows.

Table 5: The main role of Aspire to STEM CPD recipients

	No.	%
Teacher	812	66%
Senior leader (Head Teacher)	120	10%
Middle leader	139	11%
Teaching assistant	58	5%
Technician	20	2%
Other	29	2%
Senior leader	26	2%
Subject leader[16]	18	1%
Nursery Nurse	1	0%
Trainee	1	0%
Total	1,224	100%

It is unclear whether these teachers were new into their careers or roles and whether they were STEM specialists or non-specialists, data that perhaps may be a useful addition for monitoring in future. Regardless of this fact, satisfaction was uniformly high.

Table 6: How satisfied have you been with the CPD provided by STEM Learning?

Satisfaction	No.	%
Poor	0	0%
Fair	14	1%
Good	110	30%
Very good	519	38%
Excellent	423	31%
N=	1,366	100%

Similarly, high scores were recorded by participants for the quality of the CPD received.

Table 7: How would you rate the overall quality of CPD you have received?

Overall Quality of CPD	No.	%
Poor	0	0%
Satisfactory	21	1%
Good	429	30%
Very good	989	69%
N=	1,439	100%

Further analysis found that within this sample were head teachers (120) who rated the quality as good (68%) or very good (29%) and middle leaders (139) who rated it good (19%) and a higher proportion still rated it very good (76%).

The next table confirms that the Aspire to STEM CPD experience, for most was a very positive one, meeting not only immediate requirements, but having the potential to create further change in future as participants apply their learning in school and improve their practice for the benefit of their pupils.

Table 8: Aspire to STEM CPD Teacher Feedback

	Disagree strongly	Disagree	Agree	Agree strongly	Base	Rank[1]
The CPD was well organised and planned	0%	0%	32%	68%	1,513	1st
The CPD was relevant and useful	0%	0%	33%	66%	1,516	2nd
Learning outcomes for this CPD were met	0%	0%	35%	65%	1,509	3rd
The CPD will have impact on my future practice	0%	1%	39%	60%	1,509	4th=
The CPD will have impact on the students I teach	0%	1%	39%	60%	1,496	4th
I will share this learning with other colleagues (in our school, school grouping or in other schools)	0%	1%	40%	59%	1,493	6th
It has improved my subject knowledge and skills	0%	2%	42%	56%	1,507	7th

Participants were asked why they found their CPD useful. Over a thousand comments were collected and summarised next. Whilst there were some convergent themes across all roles, the comments revealed slightly different reasons as to why the CPD was useful for specific roles suggesting that AtS has managed to provide customised, relevant and valued CPD experiences for a range of teaching staff in the targeted schools.

Photo used with permission by Downs Barn Infant School

Table 9: 25 reasons that participants found Aspire to STEM CPD useful

Whole Sample – 25 reasons the CPD was felt to be useful
1. Practical ideas (e.g. hands on experiments / activities / use of equipment) for a STEM subject
2. Assessment information / ideas and resources
3. Ideas (fun, engaging and practical) for use in class and outdoors
4. Sharing practice with peers, others from outside the school, feeling of collaboration (thinking time)
5. Pointers towards inexpensive resources to use in lessons / school (books and websites to help with ideas)
6. Thought processes (focus / investigation ideas / question progression) / discussion with peers
7. Enhancing knowledge of the elements of working scientifically and how to incorporate these into lessons
8. A better understanding of stimulating pupils in the learning environment
9. Ideas on improving engagement and planning for impact
10. Use of vocabulary to embed in teaching practice and encourage open ended conversations with students
11. Helped understand how to set clear targets
12. Sharing of resources, discussion of issues across other schools too
13. Cross-curricular connections (Maths / Science / English / literacy / numeracy / History / Geography)
14. Leadership strategies
15. Reviewing concepts with colleagues
16. Investigations and opportunity to participate first-hand
17. Relatable practice / classroom stories and experiences
18. Information helpful to NQTs and non-specialists
19. Challenging pre-existing attitudes / practice and knowledge to encourage a change in practice
20. Lesson structure / planning improvements
21. Empathy - experiencing activities as the children would
22. Planning / effective approaches to CPD
23. Understanding how to apply science skills in an interactive environment
24. Learning from STEM Ambassadors
Base: 1,094 feedback comments

The most common feedback was around how the CPD was practical, not only in its delivery, but also in how the learning could be applied practically back in the school environment.

The least referenced aspect was around knowledge about STEM careers, instead the feedback was largely about pedagogy, improving teaching practice, being made aware of inexpensive resources to use and sharing ideas about how to improve pupil outcomes.

Feedback was most positive when teachers had been highly interactive during the CPD sessions, doing experiments themselves and empathising much more with the experience that their pupils might have when doing similar experiments in school. The CPD appears, for some, to have challenged pre-existing ideas about how Science, in particular should be done, with some commenting on being more open to letting the children lead, have more freedom and make better use of the outdoors environment in future.

Reasons why different teachers found the CPD useful are illustrated through selected quotations in the following table.

Table 10: Usefulness of Aspire to STEM CPD for different teacher roles

(n=1,094 comments made by participants)

Head Teachers	Senior Leaders	Teachers	Teachers	
• *Assessment of Science and how to build it into the current scheme of work that we use*	• *Developing cross curricular links was fantastic full of ideas. Curriculum progression docs*	• *Discussion with other professionals, info for primary curriculum approach*	• *5 types of investigation - who knew? A really helpful guide to ensure great science planning*	• *Being able to take part in the investigations – first-hand experience*
• *Components of CPD that make it effective, 5 stars!*	• *Practical and sensible ideas inductions - very realistic information*	• *Discussion with others about how to contextualise material*	• *Explaining any misconceptions*	• *Charlie and the chocolate factory - linking literacy and science*
• *Cross curricular connections (Literacy / Science), ideas to enhance and enrich my teaching and improve outcomes for children*	• *My best sessions was the English and Science one. I could really see how it used work in the classroom.*	• *Every session I attended gave me food for thought, but I am excited to set the farming challenge*	• *Activity based ideas which link to the NC teaching*	• *Cross curricular ideas - Science/History/Geography/. Good to listen to other people and share ideas*
• *Different ways of getting children to investigate and generate questions more independently*	• *Practical and sensible ideas inductions - very realistic information*	• *Experiential learning and collaboration with others to model a good lesson*	• *All the activities were relevant to specific year groups*	• *Conversations with people outside of school*
• *Examples of the pathways and sequences to trace students*	• *Standing on the shoulders of giants workshop because it gave practical ideas to use in my teaching*	• *Great ideas for lesson structure/progression*	• *All of it as a non-Physicist NQT!*	• *Different ideas about approaching group work changing approach by making discussions more personalised*
• *Fun activities to do with the children to engage them in scientific thinking*	• *The conversation about vocabulary made me consider how to use more / embed more*	• *Funding availability and ideas on how to access the funds*	• *Assessment information / ideas and resources*	• *Discussion of how to enthuse students working at 1 - 3 reflection of research showing that streaming is best for student achievement*

Head Teachers	Middle Leaders	Teachers	Teachers	Teachers
• *Mostly, the fun in Science! The practical investigations were exciting and thought provoking*	• *Networking, value of resources shared are invaluable*	• *Good subject knowledge information - Good suggestions of focussed Science based lessons/activities*	• *Simple and practical guidance (including EYFS[17]) by someone who is really passionate about the subject*	• *I found it useful to find new ways to link Science into the curriculum*
• *Practical approaches, humour, great ides to take back, simple Science FUN!!*	• *Some fantastic ideas to try, shows progression of learning*	• *Great ideas to use NOW*	• *Practical application for aspects like assessment recording*	• *Ideas for initiating scientific discussion*
• *Practical science outdoor covering lots of investigations relevant to primary curriculum*	• *Leadership styles*	• *Guidance re student-led enquiry - will be more confident in this in the future*	• *Practically having a go. Challenging what we already thought we already knew. Examples of cross curricular and how to transfer skills / learning*	• *Ideas to teach scientific skills, e.g. Explorify WTS, EXS, EXD standard statements*
• *Practical, progression elements, subject knowledge development, quality of handouts*	**Teaching Assistant / Technician / Trainees**	• *I enjoyed learning new ways of recording Science which makes it more interesting for the children*	• *Practical activities - Story telling planning - Oracy through science*	• *Interesting ideas of how to allow children freedom with a set experiment*
• *Real life classroom stories and examples from past teaching experiences - made it real and were humorous*	• *Practical ideas for team building / cooperation*	• *I enjoyed the rocket making and testing. Year 6 learners would love to make and test it and they will also be able to test different variables to see different results*	• *Relating the Science activities to the Maths curriculum. I particularly enjoyed the rocket activity as my class would enjoy that*	• *Info about slowing down lessons and trying not to cover everything in one lesson and focus on small parts in detail!*
• *Talking through practical investigations and how to record*	• *Being able to use everyday objects*	• *People sharing examples of what to do and what not to-do in CPD. The opportunity to practise in small groups*	• *The challenge to review Key Stage 3 practical work. How to expand students thinking*	• *Titration a carbonate (fizz and point) benefits of using correct / better indicators*
	• *Group mind-mapping*			

Head Teachers	Subject Leaders	Subject Leaders	Teachers	Teachers
• *The practical experiments were superb! Also, a lot of the activities made me think about how best to assess the pupils learning - good mix of practical and theory*	• *Having time to sit and talk to teachers in the same academy. Having input from Allie to steer in right direction and highlight resources to use and where to find things with a clear vision*	• *Sharing practical ideas that can be used in the classroom for the teaching of Science - including teaching about famous scientists*	• *The Science assessment sessions was the most useful as it will support me with planning and accurate assessments*	• *Understanding where Science fits into the curriculum, linking it with other subjects, encouraging child led enquiry*
• *Using cheap and readily available materials*	• *Choosing key action points*	• *Speaking to STEM ambassadors- got ideas for lessons and events*	• *The opportunity to meet the STEM ambassadors*	• *Ideas for science afternoon KS1*
• *How Maths can be incorporated in different ways*	• *Ideas and techniques for teaching*	• *Strategies of engagement and motivation*	• *How to engage pupils in open ended discussions*	• *Linking books to Science and back to English*
• *Separation of enquiry into key area to ensure coverage of WS*	• *Ideas to teach creatively and ideas how to engage*	• *The chance for us to be away with the department whilst thinking and responding positively to consider what we can try next*	• *Understanding of how to organise progression ideas for ways to record - not just a Science write up*	• *Mathematics and Science - how to focus on Science for children where literacy gets in the way*
• *Learning how to give pupils more freedom with experiments*	• *Key requirements of subject leader – clearer*	• *Practical use of equipment - recording data on graphs*	• *Understanding how to apply Science skills in an interactive environment*	
	• *Monitoring of subject – CPD*			
	• *Meeting different people. Thinking about how STEM fits with humanities subjects*			

5 Whole school case studies

The seven following case studies ('complete journeys') seek to illustrate how the Programme has sought to make a difference in a whole school context. Interviews in March 2020 with key contacts from each school and their respective Educational Lead have helped to understand how the Programme has contributed to STEM in each school.

Case study 1

This first case study suggests that despite the schools' Ofsted rating declining since AtS commencement, there have been STEM subject measurable performance gains, increased parental engagement as a result of targeting the most disadvantaged families in the local community and a subsequent, marked increase in the take up of triple Science by students. It suggests growing Science capital and improved teacher pedagogy.

Haydock High School

Since the AtS Programme began this school, despite its overall Ofsted rating falling, has seen positive gains in STEM subjects and attainment results. In fact, the % of students achieving EBacc 2 Science has increased from 41% (2018) to 55% (2019). The Science value added measure has improved across the board, with FSM students seeing positive change (-0.88 in 2017, -0.80 in 2018, -0.16 in 2019). These results are all the more impressive because in 2019 the school catered for an increase in previously low attaining students, an increase in FSM, SEN and EAL students[18].

With staff turnover high, poor teaching and pupil outcomes, each of the STEM subjects were prioritised. Engagement data shows that between 2017 and 2020, Haydock High School has accrued 9.6 CPD units over 13 AtS events and activities. This is the equivalent of 48 CPD hours. CPD, with a focus on triple Science has taken place, and combined with enrichment events (which targeted the most disadvantaged families) has led to an increased take up in this subject from 2 to 18 students. Parental engagement has also improved as a result of the event, an indication of growing Science capital in the local community.

Other department leaders have benefited from networking and learning with their peers and sharing good practice. Partnership meetings take place every half term and include CPD in order to incentivise attendance. As schools' priorities have changed, these Partnership meetings have raised priorities, and enabled the Educational Lead to source appropriate training (at Haydock this has included a focus on Computer Science).

The Educational Lead observes that this school, like many others, has seen variable progress linked to staff capacity. Nevertheless, the updated needs assessment shows positive change across all four subject performance criteria[19] between the start and end of the AtS Programme moving from a score of 3.05 ('requires improvement') in all 5 STEM subjects assessed to a score of 1.35 ('outstanding') by the end of the Programme.

With a stabilised team, teaching and morale have improved. GCSE results at the school have also improved from below to above the national average. The Head of Science has completed facilitator training and then delivered training to his peers. Key success factors were identified as bespoke training, financial support and SLT backing and trust. Barriers have centred on capacity and staff turnover which has led to schools disengaging for a period while relationships are re-established.

The Aspire to STEM Programme was a timely Programme for this school. It enabled a new head of Science to rebuild and develop the department with bespoke training and export support from the Educational Lead. Its greatest gains in terms of maturity over the two years have been in the CPD for STEM teachers and STEM enrichment.

Outcomes have been reported for each of the target audiences' leaders, teachers, the school, pupils and the community. The focus on triple Science through the CPD and enrichment events for disadvantaged pupils and their families has seen a large increase in the numbers opting for this subject, from a point where it was not viable. Three of the schools in the Partnership, including this one, are planning to form an Enthuse Partnership.

Case study 2

This next case study finds there is much activity still pending for this school. As a small school, restricted in staff numbers, STEM budget and facilities, it has proved challenging to support staff to access the CPD identified. Nevertheless, an enrichment event for feeder primaries attended by 150 children has been successfully delivered and has resulted in improved collaboration between local feeder schools. While there was not considered to suitable CPD for subject leaders, the quality of STEM teaching, particularly focusing on supporting non-specialists has supported staff to feel more confident, and pupil outcomes are expected to improve over the next two years.

Danesfield Church of England Voluntary Controlled Community Middle School

This middle school was part of cohort 2 and engaged in the autumn term of 2018. The school has remained as 'requires improvement'. The key contact took over in 2019 and observes that the original Delivery and action plans were aspirational. In reality, there has been a greater need for staff CPD, and there has been less enrichment, although what has taken place has been highly valued.

"Seeing very young people's reaction was uplifting and confirming that teaching is a worthwhile and beneficial vocation. Knowing that at least some of the children have been inspired into Physics and Sciences makes you feel hugely proud and satisfied."

Staff turnover, and wider school changes have made a difference to the extent to which the school, and others in the Partnership have engaged. Capacity issues, and challenges funding cover (particularly for York-based courses) have reduced the take up of training.

The physical and budgetary constraints in the small school are also seen as blockers to sustaining the positive outcomes generated by enrichment events in pupil enthusiasm and motivation. Relationships with feeder schools have been usefully improved.

Without funding, it is unlikely that staff would have been able to access the CPD taken up, with more pending.

From an Educational Lead perspective, there has been much process learning, for example around handover and the profile of AtS within the school. The Programme has been valued, and the key contact would commit time to future STEM learning programmes.

Without AtS funding this school believes it would have been unlikely to have accessed the CPD it requires for its teaching staff and this has been of real added value. The enrichment activity has also been thought to help grow Science capital in the local community with inspiring subject coverage of space "cementing the awe that younger children have towards planets, starts and the universe."

Case study 3

This case study highlights how the combined efforts of an energetic and imaginative head of Faculty and the support and opportunity afforded through the Aspire to STEM Programme has led to positive gains for this school. The quality of leadership has grown in maturity, through middle leader training. As this training was in addition to previous NPQML training, it would have been unlikely to be supported without AtS. Teachers, including the head of Faculty, have gained confidence in teaching KS3 and KS4 physics as a result of the training for non-specialists received. Their teaching is seen to be more convincing than before. The face to face training has benefited the whole department and has been applied to improved schemes of work and more engaging lessons.

Sutton Academy

This mixed secondary school, rated as 'requiring improvement' has engaged with AtS to develop the quality of Science teaching in the school which was underperforming relative to other departments. This aspect of the school is now rated as good. Sourcing support in physics was a priority as they lacked a subject specialist.

This school has gained 20.63 CPD units across 23 activities, which equates to 103 CPD hours. The face to face training has benefited the whole department and has been applied to improved schemes of work and more engaging lessons. STEM clubs have inspired KS3 pupils, while in KS4, AtS has supported the journey of five young women to the national finals of the Big Bang Fair with a Shrek based device for use in hospital waiting rooms. Without funding, it is unlikely that most of the training would have taken place, and funding enabled the team to travel to Big Bang events. While improved outcomes are seen as a longer-term ambition, the profile of STEM is higher in the school and young people are talking and enjoying the subject more than was the case previously.

The lead contact was a new head of Faculty and benefited from middle leader training and support which helped her to lead her new team.

AtS is part of this inspiring story, supporting travel costs, but also advising on how to increase the profile of STEM in the school. While there have been gains in developing Science capital, it is acknowledged that there is more to do in this area. There are few STEM employers of note in the area, and as a result, pupils lack role models and sight of STEM roles reports the school.

Case study 4

This next case study shows how this cohort two school, rated 'good', has seen a range of positive outcomes from the AtS Programme since it engaged in September 2018. The Science department was the focus, and the team have been able to access bespoke CPD to enrich their lessons, with a goal of making STEM more fun for pupils. And not only fun, with careers events helping staff to connect lesson content to real life applications in the workplace. These events have also involved other schools, and new connections have been forged between the respective heads of department.

KS2 pupils have taken part in an event for feeder schools designed to improve their transition to secondary teaching and reducing the extent to which STEM leaders can build precision into their plans for KS3. The Programme has enabled the school to do more CPD training in Science collaboratively with other schools than would otherwise have happened. This theme of working with other schools is noted in a number of case studies and suggests this may be one of the added value aspects of the AtS Programme overall.

Ellesmere Park High School

This mixed secondary school is part of the Salford AtS partnership, and is rated 'good'. The school engaged in September 2018 as part of cohort two.

While the school identified priority subjects as Science, Mathematics and Computer Technology, the focus in fact was improving the quality, but also the fun and contextual content of Science teaching.

STEM leaders in the school have benefited from additional support, linked to the new Ofsted framework and new curricula. Improved links with primary schools has resulted in being able to develop KS3 schemes of work with greater precision, in order to improve transition into the school. Staff have received CPD to develop their pedagogy (teaching styles, theory, feedback and assessment).

There has been more communication across subjects and outwards to connect to STEM careers.

Pupils have also provided good reports on well attended STEM days and taken part in national CREST awards. There are plans to host a STEM day for 3 schools and an annual conference for primary schools.

STEM careers have progressed also. The school has valued the chance to look at Science from a career context and held a careers event (rather than the planned careers fair) with the support of STEM ambassadors and a 'speed dating' event with local employers. STEM capital is being developed with pupils and, latterly, parents though events.

The school notes that there has been added value to taking part in AtS, building on, rather than duplicating what was already taking place.

"We'd still have trained, but not to the same extent, or in the same way with other schools."

While the Programme is seen to be valuable for any school that wants to improve, it is seen to be especially useful where STEM leaders are rebuilding teams and recovering from crisis situations.

Case study 5

This next case study finds that the AtS Programme fed in new ideas, resources and approaches to the school. With funding constraints, it was considered unlikely that this support would have been accessed in the absence of the Programme.

Time / staff capacity was identified as a key factor, hampered for instance by staff turnover in the IT department, but aided by a supportive SLT.[7] The attitude, approach and freshness of the Science Coordinator was also important, as was the *'invaluable'* support of the Educational Lead.

Post project, the Partnership that this school belongs to locally hopes to continue termly catch up meetings with the cluster of schools it has collaborated with during the Programme.

[7] A 2019 Ofsted monitoring visit highlights significant staff turnover between 2018 and 2019. "*Since the previous inspection, 13 members of staff have left the school. Twenty-one new members of staff have joined the school, including a primary specialist. There have been changes at leadership level, including the appointment of a new assistant head teacher, head of sixth form, head of Geography and head of Computer studies.*"

All Saints Catholic School

Having been in special measures in 2014, leadership in the school was strengthened with the arrival a new Principal in 2015 who was reported to have created culture change in three years taking the local community on that journey with him. Teaching, learning and assessment effectiveness was described as variable across subjects in the school and whilst some gains were noticed in Mathematics between 2016 and 2018 owing to department changes made by a temporary subject leader, Computer Science was singled out as requiring particular improvement because outcomes were slower than other subject areas. Ofsted didn't scrutinise any STEM subjects in their 2016 or 2018 inspections, when the school improved its rating to 'requires improvement', but the school was told to stretch the more able pupils to reach their potential. Encouragingly, in a two-year period between inspections - the gap between disadvantaged students and their peers was closing.

The needs analysis completed by the school with their STEM Educational Lead identified that STEM subject performance was on par with non-STEM subjects, self-rated as somewhere between 'good' and 'requires improvement'. The school engaged in CPD equivalent to 5.4 CPD Units (27 CPD hours), participating in at least 9 activities, mostly Science-oriented. Staff turnover meant support to improve Computer Science was not undertaken. CPD has supported improved planning (with STEM Learning Centre resources used to work with primary colleagues to understand the level of prior learning), increased cross-subject learning, and supported the improvement in pupil outcomes. Qualitatively, it has also supported morale and retention following a period of significant staff turnover.

Sampled feedback from a teacher attending a Delivery Partnership Science Network meeting found this CPD to be of excellent quality and especially found it useful for discussing revision ideas to engage and encourage reflection by pupils. She strongly agreed that the CPD attended was well organised and planned, relevant, useful and she felt the learning outcomes had been met and that it had improved her subject knowledge and skills. She felt the CPD would impact on her future practice and on the students, she taught and committed to sharing the learning with others. This teacher, however, found the online resources at www.stem.org.uk to be of little use to them.

The school's continued commitment towards staff training, increasingly individualised to each person's needs, is perhaps an inference that the AtS Programme, along with others, is contributing to positive pedagogy gains at the school since 2016. New employer links are being established as part of an improved planning process. The school has focussed on 'stretch and challenge' in CPD and subject leadership. This kind of activity is reported by the school to be having a positive effect on teacher practice and pupil grades.

Case study 6

This sixth case study demonstrates that even with a modest investment in CPD (less than 5 hours), the AtS Programme can still make a difference, and be embedded, if targeted in the right way and at the right person / people at the right time.

This primary school, judged as requiring improvement since 2013, has used Aspire to STEM as part of a wider focus on developing middle leaders. The lead contact (2 years into his career), over a four month period, has gained valuable primary-orientated CPD which has helped him, as new subject lead, to improve the profile of Science in the school, enhance planning and curriculum content (by broadening the types of enquiry used, not only in Science but across the school).

Oakfield Primary School

This primary school (larger than average with c300 pupils) was assessed by Ofsted as 'requiring improvement' (since 2013) and again at the most recent inspection in November 2018. This last inspection noted that a new head and staff needed time to drive improvement and counselled them to focus on the quality of teaching and learning and connecting plans for improvement to pupil outcomes.

A needs assessment process was carried out at this school, using the optional toolkit, and completed by 12 members of staff. This mapping process identified confidence and skills gaps in delivering practical's in Science, STEM enrichment and careers information. In turn, in November 2018, the inspectors also noted that middle leaders were accessing the professional development they required. Nevertheless, it was judged unlikely that the school would have engaged to the same extent were it not for Aspire to STEM.

Between November 2019 and February 2020 this primary school has taken part in 4 activities, the equivalent of 0.9 CPD units (4.5 CPD hours).[8] The Aspire to STEM Programme has helped to improve the focus on Science in the school. AtS training content has formed part of the next available inset day.

Attending a Help! Course for new middle leaders has been formative. The learning from the course, and the expanded set of resources available, then informed the planning and delivery of lessons – particularly by expanding the types of enquiry used. The skills and confidence gained from Aspire to STEM are expected to be beneficial when the school receives its next full inspection (expected in autumn 2020).

Raising aspiration is seen as important at this primary school, after building teacher confidence, and developing employer links is a medium-term priority (2-3 years' time).

This primary school has matured from a beginning point to seeing initial results in 3 of the 5 domains tested. Subject leadership and STEM careers are at the 'early progress' stage, as is 'collaboration with other schools.

Teaching staff have gained confidence and benefited by increased sharing resources in STEM subjects. The Programme is part of wider school improvement in assessment of work. Increased awareness of STEM careers is a priority for the coming year and beyond, but efforts are made to link subject teaching, including sport, to STEM roles. STEM (as well as other after school clubs) are open to all, including more vulnerable young people.

Case study 7

This final case study highlights how the Aspire to STEM journey has mirrored the progress of this infant school's STEM lead. After a slow start, the profile of STEM has improved, and learning about assessment approaches acquired at the STEM Learning Centre have taken root across the entire school. STEM enrichment has also made a strong start and created the realisation that this type of event can become part of the school's annual calendar and whetted the appetite to explore STEM capital across the diverse communities served by the school. Positive improvements in maturity were particularly noticeable for CPD for STEM teachers, where there is now a more defined culture of CPD emerging. There is a desire in the school to continue to learn and develop, and it will explore future ways to engage with the STEM Learning Centre.

[8] This suggests a slow gestation for AtS, as the school first engaged in July 2018, 17 months before. The spike in activity is perhaps linked to the lead contact taking on responsibility at this time.

Downs Barn Infant School, Milton Keynes.

The Programme had a slow start: *"It was hard to get people to want to go on courses to start with. Our journey was quite slow."*

An inspiring Institute of Science day in October 2019 changed this *("suddenly the penny dropped…"*), and generated a strong appetite for Science CPD.

As a new leader in STEM, the most valued aspect of support was a 3-day residential course. A key take out from the training was how to more effectively record and plan STEM lessons. The Educational Lead talked about how the STEM facilitators course proved very adaptable to suit middle leaders. *"The first day is also entirely applicable to STEM leaders – to build their self-confidence. They are then encouraged to take this back to their school, for example securing 10 minutes at staff meetings on a regular basis.*

This school also liked the 'Role of the science subject leader' course. CPD was valuable for the whole school, but for middle managers especially.

"The facilitator was wonderful. She showed us how to integrate STEM into everything and to make it child led. She gives children a stimulus and lets them go but captures what they were doing."

As well as improved assessment, this approach does rely on the subject knowledge of the class teachers.

The Education Lead observes that this school did not have experience of delivering STEM enrichment events prior to AtS. The Royal Institute show was a highlight of the school's journey with AtS. In total, 147 parents and pupils and staff took part

The RI event was described as *"a great starting point for our community"*, and there are plans to invite them back for further session(s) in 2020/2021.

The school considers that the CPD and enrichment received (9 hours) would not have taken place without the Programme, as funding is very limited.

Creating a more defined start and end to the Programme. A launch event or video would facilitate quicker buy in across the staff team, while celebration or learning events would enable schools to learn about good practice across the Partnerships.

Key Points

These case studies suggest that each school's journey has been slightly different not just because of the amount or type of CPD they received from the Aspire to STEM programme, but also because of the preconditions within the school prior to the Programme's commencement.

Similarly, their STEM subject performance ratings and maturity at the start of the Programme may have differed affecting the needs that were prioritised for the support that was accessed. Over the lifetime of the Programme schools reported a variety of enablers and blockers to take full advantage of the CPD and support notably stable staffing and strong SLT backing.

Some of the case studies have highlighted how inspirational community enrichment events have catalysed Science capital and enthusiasm for STEM locally.

Others have demonstrated the positive gains for teacher pedagogy from a focused approach to using the Programme's support and wider STEM learning resources.

A small number point to the added value that the Programme appears to have encouraged greater levels of STEM collaboration with local schools than might otherwise have happened.

Maturity in STEM is happening in some of these schools, and the Programme is seen to be one of a number of factors contributing to this change.

For some schools, the CPD and support provided by the Programme would not have happened to the same extent, or in the same way in its absence. It has been both a catalyst and a tool to encourage collaborative training and joint activity with other local schools.

There is a theme emerging from these case studies and the wider review of schools in this evaluation that new or recent STEM subject leads in particular appear to get a boost from the AtS support to help them have the confidence and tools to improve the profile – especially of Science – in their school.

The Programme has afforded some novel investment in activities not tried before such as STEM community events and enrichment.

There appears to have been less obvious STEM career promotion and confidence building activity amongst the sample of schools reviewed compared to their focus on improving quality of STEM teaching and pedagogy.

Despite this variety of context and progress, a number of common outcomes have been observed across these 7 schools and a further 22 that have been reviewed for this study. The next table, and following chapter of this report seeks to quantify and qualify these common outcomes.

Aspire to STEM Programme outcomes for intended beneficiaries

184 outcomes, across 27 typologies, were recorded from 29 schools examined in this evaluation. In descending order, the table below shows:

- Outcomes for teachers (52)
- Outcomes for students (51)
- Outcomes for colleagues / school (37)
- Outcome for leaders (31), and
- and Outcomes for wider communities (12).

Table 11: Outcomes by audience for 29 schools engaging in the Programme

Outcomes for Leaders	N	Outcomes for Teachers	N	Outcomes for colleagues / whole school	N	Outcomes for students	N	Outcomes for wider communities (local schools and parents)	N
Developing curricula to engage and inspire students	8	Use of new subject and pedagogy knowledge, skills and understanding	15	Improved quality of teaching overall	12	Improved students' progress in STEM subject knowledge, skills and / or understanding	14	Outcomes for partnerships and Trust / federated schools	7
Use of new leadership and management skills	6	Improved enthusiasm and confidence	15	Improved sharing of effective practice and resources in STEM subjects	9	Confidence, motivation and engagement in lessons	14	Outcomes for communities	6
Improved knowledge and skills in leadership and management	6	Increased pedagogical knowledge, skills and understanding of STEM subject curriculum / assessment / practical work / literacy / numeracy	12	Increased profile / priority of STEM in the school and within the wider community	6	Improved students' attainment in STEM subject knowledge, skills and / or understanding	9		
Improved understanding of STEM curricula	6	Improved technical skills for supporting practical work	5	Improved leadership of STEM subject areas	4	Other	8		
Increase awareness of STEM careers	2	Improved subject knowledge and understanding of areas of relevant STEM subject curriculum	5	Increased progress and attainment of students in STEM subjects	3	Improved engagement of FSM, girls, or other vulnerable group in STEM subject offer e.g. Y8/9 options	6		
Increased confidence in using data to improve student's attainment	2	Other (specify	0	More students wishing to take STEM subjects	1	Improved behaviour and safe working	0		
Other	1			Increased support to colleagues in other departments	1				
				Other (specify)	1				
				Increased capacity of department to engage with STEM careers	0				
				Increased number of students considering studying STEM subjects pre / post 16	0				
Total	31		52		37		51		13

6 Key findings by audience

6.1 Outcomes for teachers

Teachers were the greatest beneficiaries in terms of reported outcomes from Aspire to STEM.

The most commonly reported outcomes across the 29 schools reviewed were:

Improved confidence and enthusiasm

These outcomes were mainly affective for teachers affirming or re-affirming their career choice and making them look at their future with more hope, for example, this Science lead now has greater confidence to develop her career.

> *"In 2020 I began my NPQSL and this drive to continue to develop and improve the profile of Science has meant this will be the focus of my study. I will use what I have learnt in the Aspire to STEM sessions as a guide on how best to do this and develop this knowledge and understanding. As of yet this is the only training I have been on. However, as I am phase leader and the strategic lead for Science across our Trust this training has been a fantastic way to learn skills that can be interchangeable within my roles in school." Hearsall Community Academy*

The Programme has also helped re-energise departments that had been under-performing and lacking in confidence.

> *[The Programme has] enthused us, and also seeing other schools' practice. The experience has made me really appreciate our school and how willing we are to share ideas. Your colleagues are your main support – and key. It's also re-inspired me in Science, future jobs and apprenticeships." All Saints Catholic High School*

> *"Training to support non specialists has taken place. Teachers have fed back positively on the training received and are seen to more confident. Danesfield Church of England Middle School*

This increased enthusiasm and confidence were resulting in new approaches, for example, attending extra training or creating activities for Science Week.

Acquisition and use of pedagogical knowledge, skills and understanding of STEM subject curriculum / assessment / practical work / literacy / numeracy

The majority of outcomes for teachers were cognitive (knowledge) based; for example, receiving new ideas, increased subject knowledge or receiving constructive feedback.

> *"My colleague strongly agreed that the CPD attended was well organised and planned, relevant, useful and she felt the learning outcomes had been met and that it had improved her subject knowledge and skills." All Saints Catholic School.*

Improved knowledge, particularly for non-subject specialists were observed. School action plans noted that changes to the Computer Science and Physics curricula had revealed knowledge and skills gaps among staff.

> *"We all teach KS3 Physics principles which we then revisit in KS4. Teachers are more confident to deliver this content. Students know if you are reading from a script." Sutton Academy*

There were also behavioural outcomes, creating improved schemes of work, improving the quality of their delivery or attending professional networks.

Subject specific CPD had increased pedagogical knowledge and delivery.

> *"The Educational Lead found some really great training. I took part in DT CPD locally which was a priority and I've been able to think hard about how I make my lessons fun but still cover the content." Downs Barn School*

Resources shared and promoted through the STEM Learning Centre were being applied in school.[9] For example:

> *"The Faculty Lead has devised activities herself, and also utilised STEM Learning resources (for example on the chemicals to neutralise garlic for a valentine's themed session)." Sutton Academy*

A change in language used was noted by different schools; for example, using more technical language, or in another example;

> *"As a team we have asked: 'Do we understand them fully, and covering them in class? We've changed some of our lexicon, to use the language of the exams." All Saints Catholic High School*

Colleagues were also observing a change in behaviour:

> *"A recent whole school learning walk I did showed that the teachers were more enthused in lessons, the delivery was more engaging than before, and the children were responding positively to this. Teaching has definitely improved." Parklea Primary School*

[9] There were divergent views expressed about the resources linked to the Programme.

Improved subject knowledge and understanding of areas of relevant STEM subject curriculum

Although noted amongst a smaller subset of schools there was some evidence of this outcome. For example, in one primary school, teachers were able to deepen their subject knowledge, as:

> *"We may only teach subjects 'a thumb nail at a time' in primary, but teachers need to have the whole bucketful." Oakfield Primary School*

While one secondary school felt that the approaches and learning from Aspire to STEM were valuable for the future to help staff**:**

> *"…build a web of knowledge to make subject teaching more relevant." Ellesmere Park High School*

A primary school Science Lead cascaded the learning from one course to his colleagues at an Inset day:

> *"My colleague and I redelivered one of the courses from the training, on confidence levels linked to the types of enquiries. The feedback received was that colleagues could see practical examples that they could really interact with." Oakfield Primary School*

Another primary school in this area produced a presentation to share at the end of term Partnership meeting (June 2019) – they summarised the outcomes for teaching staff as:

- Re-focused school on the Science National Curriculum (IPC).
- Up to date research reports shared.
- Progression of skills in Mathematics – not teaching measure the same way each time.
- Teacher confidence at assessing and teaching science.
- Y6 teacher – teacher assessment at end of KS is more informed.
- Teachers have a bank of ways of assessing science in weekly lessons.
- Has enabled school to add challenge and drama into lessons- and so even greater pupil engagement.

Key points

The most commonly reported outcomes across the schools for teachers was improved teacher enthusiasm and confidence that supported personal affirmation and / or helped re-energise departments that had been under-performing. This increased motivation manifested in a number of ways; for example, teachers choosing to attend extra training or creating activities for Science Week.

The second most commonly reported outcome across the schools was improved pedagogical knowledge skills and understanding which delivered cognitive gains for teachers through the receipt of new ideas, increased subject knowledge or receipt of constructive feedback.

There were also behavioural outcomes, through the application of this new knowledge. Teachers created improved schemes of work, improved the quality of their delivery and / or attended professional networks.

In addition to the pedagogical outcomes, technicians benefited by improved skills to allow them to support practical work in the classroom. This has been achieved by sharing knowledge between schools or creating a technician's network, rather than through training.

An example of outcomes linked to improved knowledge and understanding of areas of relevant STEM subject curriculum was gaining wider subject knowledge by primary teachers.

6.2 Outcomes for leaders

Leaders have been defined as senior, middle and / or subject leaders within a school. A review of the 29 schools identified the following outcomes for leaders as most prevalent:

Improved knowledge and application of skills in leadership and management

Aspire to STEM enabled middle leaders to develop or further develop their skills and knowledge in leadership and management, for example:

> *"The course has taught me how leadership styles differ and how best to approach and support particularly those who can be difficult to manage." Hearsall Academy*

The Programme's face to face delivery of CPD meant that there was peer to peer learning, especially valued by more junior leaders.

> *"It was a chance to talk to other subject leaders, and it was so great to see how more experienced teachers do it." Oakfield Primary School*

The application of leadership and management skills saw leaders develop their reflective practice, curriculum and subject action plans.

> *"IT is a department of one, but he is now networked to colleagues in other schools and is going to look at schemes of work and planning" Haydock Park High School*

Improved use of data and assessment also enabled subject leaders to put in place the appropriate support needed to reduce the gap between pupil outcomes. One demonstrable example is a school that has sought to liven up their Science delivery and are seeing a greater response from students who were less engaged before.

> *"Children who usually need more encouragement in Science lessons were more involved in the Science work. Children enjoy learning the scientific vocabulary and are able to use it with more confidence." Parklea Primary School*

Behavioural outcomes were also coming through, for example:

> *"The facilitator was wonderful. She showed us how to integrate STEM into everything and to make it child led. She gives children a stimulus and lets them go but captures what they were doing. Now I try not to be too prescriptive, as this limits the extent to which staff engage in the content. I try to give them the knowledge, then allow them the freedom to 'let it go' in their way. It has also helped me in my leadership role as I feel I have 'lots more backbone' to ask for CPD. My class is my case study for how beneficial CPD is." Downs Barn School*

Developing curricula to engage and inspire students

Outcomes for leaders to develop curricula and inspire students included cognitive outcomes (new knowledge), and skills outcomes (e.g. improved planning and embedding a culture of subject leadership).

Leaders have received consultancy support and CPD to enable them to both fulfil the requirements of the National Curriculum and make the content and delivery more engaging and inspiring.

> *"It is not just about doing an interesting activity they have found; it is looking at why things happened in more detail. Using more scientific vocabulary in lessons and expecting the children to use it when they are talking about what they are doing". Parklea Primary School*

> *"Also, as a result of the training, teachers are beginning to take more of a constructivist approach to science teaching, by exploring the 'bigger picture' of science beyond it just being a topic in school." Bilston C of E Primary School*

One secondary school was supporting their feeder schools to develop a more ambitious curriculum, and also expected to deliver less re-work with the next intake of Year 7s.

By refusing on the Science National Curriculum (to quote one primary school), there also appears to be an attitudinal shift,

> *"It's the training, getting different ideas and not just getting through the curriculum. It's better preparation for exams, and to prepare them to be young scientists. For example, AO1, 2 (application) and 3 (scientific skills) questioning. As a team we have asked: 'Do we understand them fully, and covering them in class? We've changed some of our lexicon, to use the language of the exams." All Saints Catholic High School*

Leaders were encouraged to 'break down the barrier between subjects', resulting in increased cross-curricular links:

> *"Cross curricular connections (Literacy / Science), ideas to enhance and enrich my teaching and improve outcomes for children" (AtS D3 form feedback)*

Improved understanding of STEM curricula

The needs analysis process and Educational Lead support provided the mechanism whereby leaders could reflect on their development needs. As noted, change in the curricula for Physics and Computing Science were areas where knowledge gaps were identified.

> *"As areas of the A-Level curriculum have dropped into the new GCSE curriculum, staff also need to ensure that their subject knowledge is up to date and supports the demands of getting a grade 9 in STEM subjects." (Lord Derby Academy)*

This was also a priority for primary schools. For example, Willens Primary School's action plan noted that developing Computing across the curriculum was a whole school priority.

Leaders were connected to up to date resources, including research, to increase their knowledge of STEM curricula.

> *"Ensuring that teachers have access to the most useful and relevant resources, ideas, websites, etc. to deliver high quality lessons." (4 Scunthorpe primaries)*

While developing STEM curricula knowledge is relevant to all staff, non-subject specialists were a cohort of particular importance, as in this example from a middle school.

> *"Staff shortages mean all teachers cover more than one subject. For example, an art teacher also does DT and a music teacher who is being trained (by the Assistant Head and Head of Science) to teach Mathematics. A priority therefore was the training for non-specialists. The county also lost their computing lead, which placed the onus on teachers to join hubs."*

Leaders experienced affective (social and emotional) outcomes as a result of their CPD especially new subject leaders who were enthused with the culture of learning and development they accessed through the STEM Learning Centre. This increased motivation was being channelled into improved planning and schemes of work in their schools.

> *"I feel like I've excelled more with Science because of Aspire to STEM (compared to History)."*

In turn the confidence of staff teams increased:

> *"Staff voice feedback found significantly more positive comments about the direction of Science following this Aspire to STEM support. Staff are more confident than before to use the various schemes available for teaching Science whilst also understanding national curriculum requirements." Hearsall Academy*

Spotlight: Oakfield Primary School

"As part of the 'Help! How do I lead primary Science' CPD residential on the 20th December 2019 we (2 members of staff) undertook training on the 5 types of enquiry. On the back of this the types of enquiry being undertaken across the school was examined, processes put in place to encourage a range of enquiry types used and delivery of CPD back to all class teachers on the different types of enquiry… [This allowed] the finalisation of the mid-term spring plans for Science and identify activities that could be used to include a range of types of enquiry. It was by far the best CPD I have attended since the beginning of my teaching. The environment at the STEM centre, York was so encouraging to goals of the course and most importantly it gave us many tools to come back to the school with to help with subject leadership duties and try to make an immediate improvement in the teaching across the school."

Key points

The application of leadership and management skills saw leaders develop their reflective practice, curriculum (for example using Mathematics in Science) and subject action plans (linked to the areas of the curriculum staff were responsible for, so a D&T lead improved her subject planning at primary level)

Improved use of data and assessment were also enabling some subject leaders to put in place the appropriate support needed to reduce the gap between pupil outcomes.

Outcomes for leaders to develop curricula and inspire students included cognitive outcomes (new knowledge), and skills outcomes (e.g. improved planning and embedding a culture of subject leadership.)

CPD training to develop middle leaders' knowledge of STEM curricula took the form of cognitive (knowledge based) outcomes, for example on exam questioning, or the different types of enquiry.

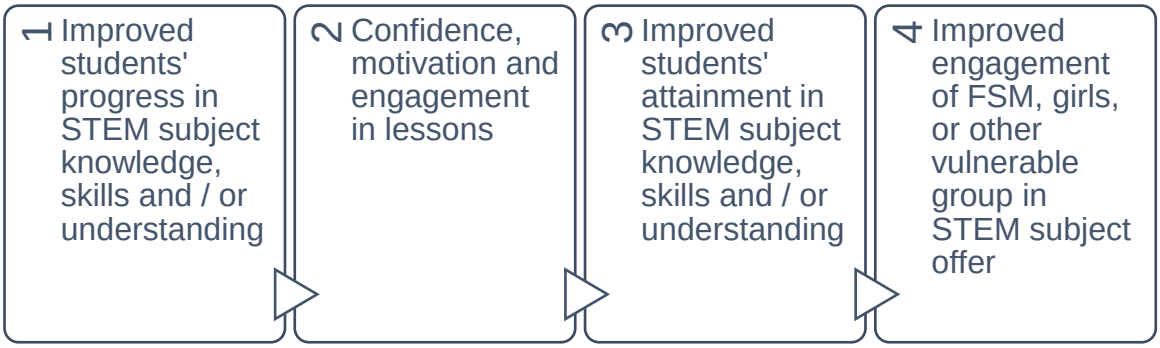
Aspire to STEM has enabled middle leaders to develop or further develop their skills and knowledge in leadership and management. Cognitive outcomes included awareness of the different styles of leadership and how to deploy them.

Outcomes for leaders linked to increased awareness of STEM careers were affective (creating a culture where departments wanted to know and share their careers activities and employer connections) and cognitive (greater awareness of STEM activities and practices of other departments)

Other outcomes for leaders included qualitative feedback that retention had improved (please see ‘Attribution’ section 8 of this report).

6.3 Outcomes for students

Ultimately it is hoped that Aspire to STEM will raise pupil aspirations and STEM outcomes. The evidence gathered for this review suggests that as a result of improved teaching and enrichment staff are observing a range of outcomes that support increased aspirations and that in doing so, more broadly, Science capital is growing amongst students and their families where conscious efforts to work with these audiences in combination.



Improved students' progress in STEM subject knowledge, skills and / or understanding

Increased student awareness and engagement were precursors, or enablers, to developing their STEM competence.

> *"You can see a difference in enthusiasm, we can ask them about Science, and they can tell us how they feel about it." Sutton Academy*

Practical work, whether in lessons or extra-curricular activity, supported these gains. There appears to be greater emphasis being placed on making learning more child-led.

> *"The students loved the opportunity of being able to create their own experiments, designs and products. I tried to make learning child-led so that they could solve problems for themselves rather than telling them what to do." (Willen Primary School)*

> *'Discussion of the event in Biology lessons relating to the GCSE curriculum.' Irlam and Cadishead College*

> *"I love doing the practical investigations; we get to think up our own questions." Caitlin Y5 Althorpe and Keadby Primary School*

Improved awareness, understanding and use of technical language was observed:

> *"Children enjoy learning the scientific vocabulary and are able to use it with more confidence." Sundon Park Junior School*

The types of questions used in GCSE examinations was also the focus of attention; supporting students to understand and formulate stronger responses. In one secondary school, the outcome of this work was seen in improved mock exam performance.

Confidence, motivation and engagement in lessons

Outcomes for students were mainly affective, increased enthusiasm, engagement and (re) inspiration. These outcomes were manifest in the form of 'amazing and thought-provoking questions'.

> *"The show had the wow factor, promoting interest and engagement in the subject from parents and students." Haydock High School*

> *Students have been disillusioned previously in Science due to some poor teaching / lack of engagement. This has improved recently due to improved teaching and improved curriculum, but work needs to be maintained/ improve consistency." Sutton Academy*

> *"The children saw that Science is not just in Science lessons making it more relevant to them. There has been improved curiosity in lessons from the children and deeper discussion about what Science the children could see in the experiments. There's been more discussion about how Science (and experiments) could be applied in real life and generally more pupil engagement in Science lessons and a desire for more practical experiments." Parklea Primary School*

Science Capital

> *Science capital itself is a measure of your engagement or relationship with Science, how much you value it and whether you feel it is 'for you' and connected to your life. It highlights the significance of what you know about Science, how you think about it, what (Science related activities) you do and who you know in shaping attitudes and feelings about STEM."*[20]

Of the 8 aspects of Science capital[21], the case studies and primary research have found examples relating mainly to:

- Science literacy
- knowledge
- Participation in and out of school learning activities
- Knowledge about the transferability of Science.

Less commonly reported were:

- Talking to others about Science
- Knowing people in a Science related job / role.
- Family Science skills.

Increased Science capital has been reported across Partnerships as a result of enrichment events led by The Royal Institute in particular:

> *"The children saw that it was possible for a 'real' person to create and engage with Science and have been highly motivated in their Science lessons since. One child at parents evening said to me 'I love Science now, in my old school I didn't but I do now.'" Downs Barn Infant School*

Further examples included:

> *“As a school we seek to provide different experiences and involve them with new situations – get them more outward looking.” All Saints Catholic High School*

> *"The children are talking about themselves more as scientists and engineers and hopefully when the RI return there will be a real connection between their own Science learning and that which the show demonstrates. The Science stayed with them it was so captivating.” Downs Barn Infant School*

There have been challenges in bringing STEM Ambassadors to events, either as a result of negative previous experience or difficulties aligning events to availability. Nevertheless, when this was a success, the outcome was gains in Science capital.

> *“Raising aspirations is absolutely our role. Students in this area are sometimes disadvantaged and lack role models. The ambassador we saw, in his 20s and dressed in jeans, was excellent in this capacity, and very approachable.” Haydock High School*

Improved engagement of FSM[10] girls, or other vulnerable groups in STEM subject offer

Noting the geographical areas selected for the Programme, all students attending schools targeted by the Aspire to STEM Programme are in locations that face pronounced social mobility challenges.

There were a number of outcomes described by schools that were reviewed in this study where specific reference was made to vulnerable students or to girls - with striking examples that suggest some outcomes may be sustainable. STEM clubs and (to a lesser extent) activities featuring STEM ambassadors have made a positive impression on students across the schools represented. Activities are sometimes aimed at disadvantaged children and families, but more commonly ‘open to all’ (rather than 'by invite only' or just for the highest achievers).

> *“Community events-built confidence in the school and Science in particular. We targeted low income families." Haydock High School*

> *“A STEM club started and has been a resounding success. It has settled down now `to 28 across all year groups (was 60 when it began last year which wasn’t unsustainable). It’s open to everyone.” Oakfield Primary School*

The case studies written by schools did highlight where vulnerable groups had engaged more or gained particular benefit.

> *"We need to make [STEM] seem possible. Girls in my class are particularly interested in STEM." Oakfield Primary School*

[10] Free School Meal, in this context DfE’s proxy definition for a student that faces disadvantage.

Case Study

Some schools were using national competitions to raise the profile of STEM. Crest Awards and the regional and national Big Bang Fairs were the main examples.

"A group of Year 10 girls built an interactive biology project. This was developed to use as an educational tool but also to be used in medical waiting areas etc. to help poorly children learn about their body in a fun and interactive way."

The girls carried out a great amount of research and created voice recordings themselves which describe the job of each organ when the corresponding button is pressed on the Shrek body. The girls received support from a lecturer at LJMU who worked with them for free as part of his outreach work. They also had support from two fantastic companies Create Education who supplied 3D printing filament for free and Bareconductive who sent a touch board so we could create the donkey to go with Shrek." The girls presented at the Big Bang North West and won two awards: Digital excellence award (from All About STEM); and Teamwork award (from the RAF).

"*The girls have a high profile in school and are more engaged in Science",* a process supported by Aspire to STEM.

Consequently, by now in Year 11 and juggling the project with revision, they also participated as one of the c200 finalists at the National Finals in Birmingham in March 2020.[22]

The AtS Programme contributed £250 towards the project, and without finances for extracurricular activities like this one, they are more difficult to secure. AtS funding went towards the transport for the girls. The passionate Faculty Leader was the other decisive factor in the girls' achievement.

More generally, the AtS Programme appears to have complemented any school that has sought to improve the way it stretches and challenges its pupils – whether their most able and or those struggling to narrow the gap with their peers - to perform at their best, often, a criticism they may have received in a prior Ofsted inspection report:

> *"The school's desire to embed a culture of 'stretch and challenge' in CPD and subject leadership. This kind of activity is reported by the school to be having a positive effect on teacher practice and pupil grades." All Saints Catholic High School*

Improved students' attainment in STEM subject knowledge, skills and / or understanding

This evaluation method did not include direct feedback from students, and the full Programme evaluation will formally assess outcomes at KS2 and KS4. Nevertheless, teachers were reporting a range of short to medium term outcomes that the Aspire to STEM Programme has contributed towards. Skills outcomes included improved understanding and use of technical language.

> *"It is not just about doing an interesting activity they have found, it is looking at why things happened in more detail. Using more scientific vocabulary in lessons and expecting the children to use it when they are talking about what they are doing. Children who usually need more encouragement in Science lessons were more involved in the Science work. Children enjoy learning the scientific vocabulary and are able to use it with more confidence. Parklea Primary School*

In a secondary setting, understanding the format of examination questions has also been the subject of investigation.

> *"Bespoke training was key. We saw that Year 11 didn't have the technical language to answer certain questions, so were giving simplistic responses. Following training, we can see they are starting to use the right language."*

> *"The application of learning from the course back in school and the support provided has given staff and children the chance to build their Science skills too."*

There were, albeit isolated, directly attributable examples of improved outcomes in mock exams, or in one example, GCSE results (as part of an overall uplift), this was perceived as a medium to longer term outcome.

> *"This is ultimately about student outcomes, but Aspire to STEM is one of many initiatives. If young people have engaged with Science etc., then yes there should be improvement, but not a seismic shift. Teachers will have made changes from Year 1 to Year 2. For example, improved subject knowledge of NQTs in physics and chemistry then provides greater security in their delivery, their confidence and knowledge of concepts." (Haydock High School)*

Option to add in any STEM Learning review of examination performance data here in the case study schools supplied.

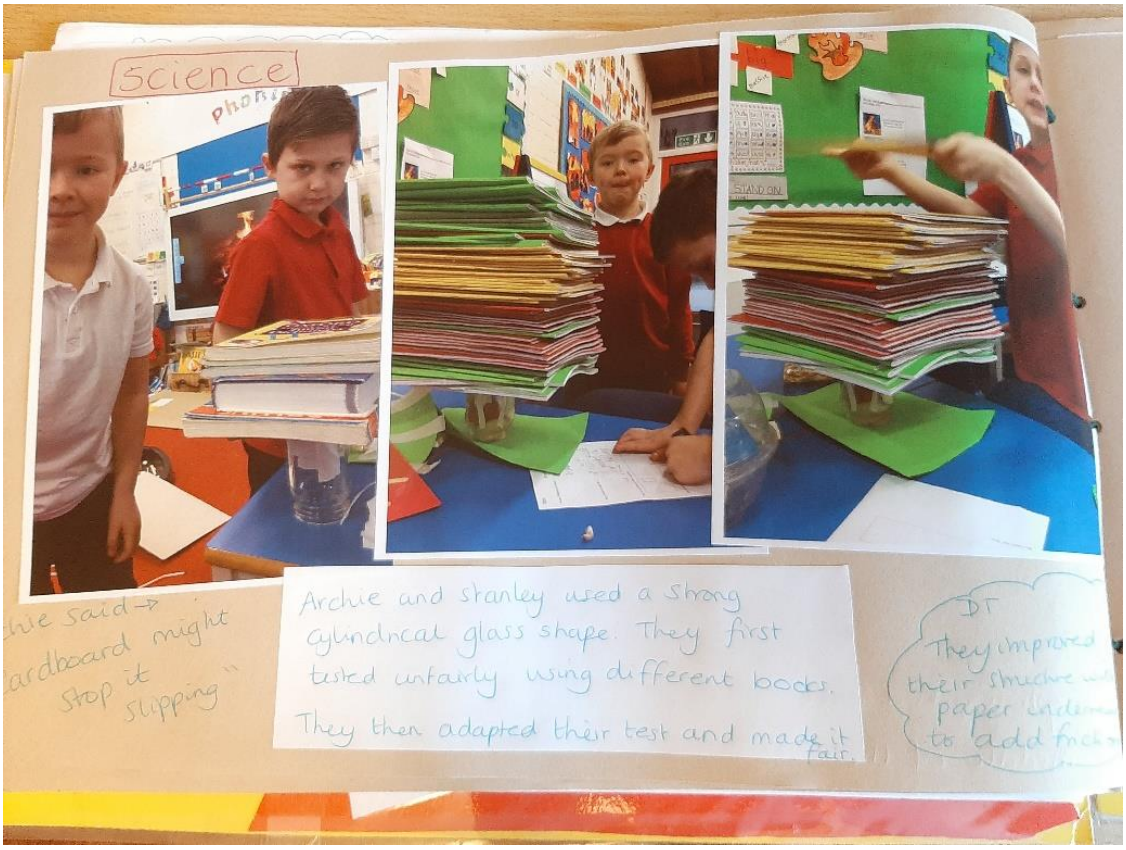
> *"Encouragingly, in a two-year period between inspections - the gap between disadvantaged students and their peers was closing. The latest Ofsted inspection report was completed in April 2018, 175 days after the school engaged with the Aspire to STEM Programme, then a subsequent monitoring visit in May 2019." All Saints Catholic School.*

> *"Teacher and learning have improved and GCSE results (grades 4-9) have improved from below the national average in 2017/2018 to 64% (with the average 55.4%) in 2018 / 2019." Haydock High School*

Key Points

Outcomes for students were mainly affective, increased enthusiasm, engagement and (re) inspiration. These outcomes were manifest for example in the form of 'amazing and thought-provoking questions' (Danesfield Middle School)

Example outcomes for improved pupil progress, skills or understanding in STEM included the use and understanding of scientific language. Other outcomes for students related to aspects of STEM capital - awareness of STEM and raised aspirations. There were a number of outcomes where specific reference was made to vulnerable students or to girls - with striking examples that suggest the outcomes may be sustainable. STEM clubs and (to a lesser extent) activities featuring STEM ambassadors have made a positive impression on students across the schools represented. Activities are sometimes aimed at more disadvantaged children and families, but equally open to all and not 'by invite only' or just for the highest achievers.



6.4 Outcomes for colleagues, the school and wider community

It was intended that AtS CPD completed by one member of the staff or teams would have a ripple effect on others in their school as knowledge is shared with colleagues. As well as this form of knowledge transfer, encouragingly, there have been outcomes in confidence, staff morale and quality of teaching as well as resource sharing, cross-curricula connections being made and collaboration with other local schools. The main outcomes observed across the 29 schools in this context of wider learning were:

Improved quality of teaching overall

Reported outcomes at school or cross-department level included applying new knowledge (as in types of enquiry), and the transfer of skills (for example in conducting assessments), or practical tips to benefit the department as a whole.

> *"The school identified a lack of chemists and physicists. Numbers for chemistry were good. Physics less so. Departments realised too that CPD wasn't for one teacher, but that the training would benefit all of them, with whole teams accessing support. Whole department teams connecting into cross partnership training." (Ellesmere Park High School).*

At primary-level, the types of enquiries covered during CPD influenced the provision across the school after it was spotlighted at the next inset day.

> *"In helping teaching staff improve their knowledge and be able to ensure a good variety of enquiries are used across subjects and as such improve teaching and learning of Science throughout the school." Oakfield Primary School*

While it is not possible to ascertain the level of attribution to Aspire to STEM, Ofsted inspection reports identify improvements that may be connected to the Programme. Two examples are summarised below.

> *"Improvements to the teaching of Science were described as dramatic. It had improved throughout the school. Science teachers had high expectations and routinely challenged students of different abilities. They used experiments to bring Science to life and enhanced the development of students' scientific skills." Fleetwood High School Ofsted Inspection Report*

> *"By 2019 the picture had reversed somewhat with Science being praised and Mathematics less so. This suggests that the school's intended interventions two years prior in Science were starting to deliver results including subject leaders receiving training and external support, specifically, to ensure the accurate assessment and moderation of students' work."' Baines School Ofsted Inspection Report*

Improved sharing of effective practice and resources in STEM subjects

The extent to which subject leads engaged with the Programme varied, with department size and capacity one variable observed by Educational Leads. Sharing resources and expertise was most commonly observed between Mathematics and other STEM subjects, however, teacher CPD feedback suggests other subjects such as History, Geography and English were also subjects that were connected in some schools.

> *"Improved liaison between Mathematics and Science. Knowledge transfer – cascading knowledge to other Science staff and increased awareness of need for cross-curricular working – and improving how Maths skills are taught." (Kirkby High School)*

Learning was cascaded following CPD:

> *"Shared resources and teach-ins back at school." Prescot School*

Increased communication between feeder and primary and secondary schools also led to greater sharing of practice in particular:

> *"Notes and resources shared within the science department. Ideas for transition work were shared with our feeder primary schools." St Thomas More Catholic Academy*

This school also identified technicians as a vital enabling factor to effective STEM teaching. In this school, like others in this study, there is only 1 technician in post, so it was decided to create a network to enable shared learning and support.

> *"Technicians are developing a support network, raising queries and sharing information through email." St Thomas More Catholic Academy*

Increased profile / priority of STEM in the school and within the wider community

An outcome that is difficult to objectively measure, qualitative feedback affirms that the awareness and profile of STEM within schools has sometimes been increased as a result of the Programme.

> *"The lead contact reports that there has been a "100% improvement in STEM profile" as a result of this Programme, with activities regularly reported back to SLT." All Saints Catholic High School*

Parent feedback is another measure of an increased profile for STEM, as in the following example. One teacher said:

> *"Parents have come up to me and other teachers and talked about what activities they can do at home because they learnt from the Parent Show that they don't have to go out and buy expensive Science kits, they can use things they have in the kitchen. Word of mouth has spread to parents who did not attend the Parent Show so they are engaging with teachers to find out what they can do and what the children are doing in Science in school." Parklea Primary School*

One middle school saw improved attendance at a parents' evening following an enrichment event for feeder schools. This was also seen to signify an improved school reputation:

> *"It showed our school in a very positive light to the members of our local community, namely parents of future children, teachers from local schools and the wider general community."* Danesfield Church of England Middle School

Improved leadership of STEM subject areas

Feedback from Educational Leads highlighted the varying support put in place to support subject leaders, all at different points on their career journey, and possessing different strengths and weaknesses.

> *"[Secondary school] still require and want subject leadership support. I work with department heads, so for example when I see one head of department, I work with them so they understand their wider role, for example data and planning. I play a critical friend role. Next I will work with SLT to hold these heads of subject to account." (Educational Lead)*

This support was typically delivered one to one, but network meetings created the conditions for knowledge sharing:

> *"Providing a forum to share collective wisdom and experience – network meetings have allowed subject leads and senior leaders to ask questions and discuss ideas that inform their practice." (4 Scunthorpe primaries)*

Subject leaders recognised that their subject leadership has benefited.

> *"I was motivated by the progress I'd made which [Educational Lead] had recognised." (William Wentworth College)*

The process of learning, reflection and application was then being applied within departments.

> *"Reflective practice is massively improved. That type of training was invaluable, it's got us sharing good practice more regularly and building in 'little and often' CPD, 5-minute starter at the start of team meetings." All Saints Catholic High School*

The resources made available by the STEM Learning Centre were used by one secondary school to work with primary colleagues to give a more precise starting point for the 5-year plan.

> *"We are talking with federated schools about Year 7 transition. KS coordinators created a scheme – involving the primaries and we made it more challenging and aspirational than before. For example, before we were covering particles at KS3, but now include atomic structure as well which helps when they move into KS4. We divided the planning work and used OneDrive, so it is a shared resource across schools." Haydock High School*

More precise data from feeder schools was helping one secondary school to create a 5-year plan (school-wide) with a more defined starting point. This was an example of where the Programme was informing whole-school approaches.

Key Points

Subject leaders were receiving bespoke consultancy support from Educational Leads to target areas of under-performance.

Network meetings created the conditions for subject leaders and senior leaders to learn from one another.

Techniques learned or sharpened were then being implemented within teams, for example regularly sharing learning at the start of team meetings. Through being involved with the Programme, leaders were in turn inculcating a culture of CPD and learning among those they managed.

Support received was enabling primary leaders responsible for multiple subjects to develop more rapidly in science than in other areas.

Aspire to STEM has enabled middle leaders to develop or further develop their skills and knowledge in leadership and management. As well as cognitive outcomes (for example knowledge of different leadership styles and strategies and when to use them), there were also affective (outcomes, especially for new subject leaders who were imbibed and enthused with the culture of learning and development they accessed through the STEM Learning Centre.

Chapter conclusions: audience outcomes

There have been 184 outcomes observed across 29 schools that have been codified by typology (cognitive, affective, skills and behavioural) and audience. Teachers have been the prime beneficiary, along with their students, then leaders within schools and finally the wider communities in which schools are located.

STEM knowledge, skills, understanding and their application in teaching practice has been the most prevalent outcome. Developing and improving understanding of STEM curricula to inspire students in more practical and engaging ways that have stretched and challenged their abilities has been a common purpose for most teachers receiving Aspire to STEM CPD.

These pedagogical outcomes are more overt compared to associated Programme outcomes in relation to giving teachers more confidence to raise awareness of STEM careers. Nevertheless, for some schools that elected to invest in enrichment and community engagement activities, there are reported gains in the growth of Science capital which requires further nurturing in order to become more embedded over time.

Compared to the expected outcomes for the Programme, the Educational Leads that were consulted, will probably not be surprised by the results, although they may be pleased to see that there have been 25 different types of outcome observed rather than just a tight core of 9 outcomes that were theorised ahead of this study to be more likely to have happened within the schools.

The review cannot be conclusive about the extent to which longer term impacts for the Programme will be achieved in respect of pupil attainment in STEM subjects or teacher retention, but there is evidence that emerging intermediary outcomes have the potential to contribute to these wider changes, noting that AtS will be just one of many factors affecting these broader outcomes.

7 Key findings by Programme aim

7.1 Improving leadership to support the teaching of STEM subjects

Seven schools reflecting on their Aspire to STEM journey considered that the quality of STEM subject leadership had improved as a result of the Programme

Quality of subject leadership	2 schools progress from 'beginning' to 'early progress' and 4 progressed from 'results' to 'maturity'.

Based on the sampled review undertaken, subject leaders (who will also teach and report pedagogical outcomes) were developing curricula to engage and inspire students, informed by a combination of CPD and consultancy support. Outcomes for leaders to develop curricula and inspire students included cognitive outcomes (new knowledge, for example about the changes to the Ofsted framework which took place at this time), and skills outcomes (e.g. improved planning and embedding a culture of subject leadership.)

> *"Developing leadership skills – ensuring that subject leads have the necessary knowledge, skills and confidence to effectively lead their subject in their school." (Unnamed Scunthorpe school)*

Senior and middle leaders have received bespoke consultancy support to support their development.

> *"I'm becoming more organised in my leadership practice and not as preoccupied with making things be perfect, which resulted in greater productivity and driving enthusiasm. (William Wentworth College)*

Outcomes for leaders linked to increased awareness of STEM careers were affective (creating a culture where departments wanted to know and share their careers activities and employer connections) and cognitive (greater awareness of STEM activities and practices of other departments).

> *"Teachers are beginning to take more of a constructivist approach to Science teaching, by exploring the 'bigger picture' of Science beyond it just being a topic in school." Bilston C of E Primary School*

Senior staff also gained outcomes from participating in the termly or half termly Partnership meeting which:

> *"Provided a forum to share collective wisdom and experience – network meetings have allowed subject leads and senior leaders to ask questions and discuss ideas that inform their practice (4 Scunthorpe primaries)*

> *"It is successful because everyone gains something from the meetings; new ideas, problem solving troublesome practicals, dealing with low service factors, having the confidence to share ideas with the group and networking. I have learnt that there are others working within the role that have far more experience and knowledge than myself, this is an invaluable resource that needs to be utilised to ensure we are learning from the best in the role." The Discovery Academy*

Cognitive outcomes included awareness of the different styles of leadership and how to deploy them. There were also affective outcomes, especially for new subject leaders who

were imbibed and enthused with the culture of learning and development they accessed through the STEM Learning Centre.

Engagement by senior leaders also facilitated greater access to the Programme by other staff.

> *"In Cumbria I was meeting deputy heads with a strategic overview. So, then we had no issues with cover or rooms or the ability to send multiple teachers." Educational Lead.*

Aspire to STEM has enabled middle leaders to develop or further develop their skills and knowledge in leadership and management. CPD training to develop middle leaders' knowledge of STEM curricula took the form of cognitive (knowledge based) outcomes, for example on exam questioning, or the different types of enquiry.

Given the wider backdrop of staff turnover, it is likely that the Programme has made a contribution to the increased retention of subject leaders (one told their Educational Lead that they would not have stayed for the school year were it not for the support and coaching they had benefited from). Feedback from the Educational Leads suggests that the length of career is a less important variable than having a mind-set that is open to change and collaboration. Having sufficient seniority to implement change within a school (or conversely, greater levels of trust shown by the Head Teacher) is a key success factor.

> *"As head of Science the Head and Deputy Head trusted me to take and lead AtS. The timing of the project was great." Haydock High School.*

The smaller staff teams in primary schools enable the dissemination of learning, and uptake of subsequent improvements to take place more rapidly. However, it is interesting to observe that overall, secondary schools self-reported larger gains in maturity than their primary counterparts.[11]

The application of leadership and management skills saw leaders develop their reflective practice, curriculum and subject action plans. Improved use of data and assessment were also enabling subject leaders to put in place the appropriate support needed to reduce the gap between pupil outcomes. More precise data from feeder schools was helping one secondary school to create a 5-year plan (school-wide) with a more defined starting point.

There were fewer outcomes reported linked to raising awareness of STEM careers or using data more confidently to improve attainment.

> *"I have taken on board a lot of strategies and continue to implement them. There is now form time revision for Year 11 and I have started to analyse data to make use of it and put interventions in place where needed. In the future, I will create a data analysis pro-forma for all colleagues to use and looking at the weak areas from last summer to improve teaching and learning in these areas." Unity Academy*

In another school a similar process has created process efficiencies:

> *"This has led to a much more fluid transition into KS3 Science with staff having more knowledge of prior learning. A lot of repeat teaching has been minimised." Ellesmere Park High School*

[11] Albeit based on a small sample, secondary schools reported greater gains than primaries in each of the aspects of maturity assessed. As noted in the method section, the opportunity to revisit the self-assessed scores completed at the beginning of the process would add a valuable, rich layer of insight.

It was observed by Educational Leads that senior teams were more focussed on attainment, with careers a less urgent priority.

> *'The school's desire to embed a culture of 'stretch and challenge' in CPD and subject leadership. This kind of activity is reported by the school to be having a positive effect on teacher practice and pupil grades.' All Saints Catholic High School*

Other outcomes

Reported outcomes for school and subject leaders as a result of collaborating more effectively together included:

- Developing relationships
- Building trust and professional networks
- Sharing knowledge (both inside and outside the Partnerships)
- Reciprocating the hosting of training.

It is apparent that within Partnerships, one school has taken more of a lead role (linked to staff capacity, typically greater in schools that were more stable / better performing), for example using STEM Learning Centre training to in turn deliver training to other colleagues.

Where enrichment events have taken place, particularly The Royal Society hosted activities, parents have been engaged (both of current and future students where feeder schools were invited). The extent to which leaders have better engagement with parents is uncertain. At this point in time, there are small numbers of instances of how this positive experience has in turn led to increased engagement[23]:

> *"Parents have come up to me and other teachers and talked about what activities they can do at home because they learnt from the Parent Show that they don't have to go out and buy expensive equipment. Word of mouth has spread to parents who did not attend the Parent Show, so they are engaging with teachers to find out the activities they can do and what the children are doing in Science in school." Parklea Primary School*

Qualitative feedback from 6 schools affirms that the awareness and profile of STEM within schools has sometimes been increased as a result of the Programme, with a further 7 examples of raised awareness and profile in the local community, particularly parents.

Often driven by a passionate STEM leader, Science-based achievements (for example reaching the finals of the National Big Bang Fair) have increased the profile of the participants and STEM subjects generally at school level.

> *"As Science lead, I believe that staff are now aware of the importance of Science as a core subject and ensure that is it never missed from the weekly timetable...For me professionally, I find it rewarding to be part of all Science and STEM tasks/training that raise the awareness and the importance of Science teaching in primary schools." Bilston C of E Primary School*

This has created confidence among both senior teams and staff.

> *"Staff voice feedback found significantly more positive comments about the direction of Science following this AtS support. Staff are more confident than before to use the various schemes available for teaching Science whilst also understanding national curriculum requirements." Hearsall Academy*

What has not been observed across the sample is leaders developing active relationships with STEM employers. Where employer links exist, these have been established as a direct connection to either the school or a teacher, rather than the Programme. Uptake of STEM Ambassadors, which featured in the majority of the Delivery Plans, but less in actuality, also point the future potential to develop improved employer engagement as a result.

> *"Schools could be more strategic about their use of STEM Ambassadors… I encouraged schools to consider other ways to use the ambassador network, for example videos and films they could show (instead of a face to face approach). Educational Lead perspectives.*

Improved leadership of STEM subject areas

While improved leadership in STEM subject areas was implicit in many of the journeys reviewed (and an intended outcome from CPD for leaders), there were comparatively few examples recorded. The two examples presented below show how subject leads either early in their career, or starting at a new school, were able to give their leadership skills a boost.

> 'A 2-day course for middle leaders was also considered valuable, building on, not replicating previous MPQ training and was *"really good to develop a new effective team, and the chance to look at other schools' practice"" Sutton Academy*

> *"[STEM leadership] has changed – planning across the school has improved, and as subject lead I can pitch in a lot more." Oakfield Primary School*

Subject leadership is of interest to Ofsted more generally. For example, our review of the AtS journey for Merrill Academy found that there was improved performance in leadership, Science and Mathematics and careers guidance since AtS commenced. These positive shifts imply that Aspire to STEM may have been a contributor to this wider change in culture driven by the head teacher in this period, but of course, would need further sources of evidence to assert with greater confidence.

Case study: This secondary school identified triple Science as a priority, and then using leadership targeted CPD and enrichment events (which targeted the most disadvantaged families) to address their need. Consequently, take up in this subject rose from 2 to 18 students. Parental engagement has also improved as a result of the event, an indication of growing Science capital in the local community.

"Community events-built confidence in the school and Science in particular. We targeted low income families. As a result of our engagement event, numbers taking Triple Science have increased from 2 (and not going ahead) to 18."

With a stabilised team, teaching and morale have improved. GCSE results at the school have also improved. The Head of Science has completed facilitator training and then delivered training to his peers, further improving the school's reputation locally.

Other outcomes for schools.

Aspire to STEM school key contacts and Educational Leads reported other outcomes as a result of being in a Partnership of schools. STEM Leaders enjoy improved connections with neighbouring schools often with little or no legacy of working together prior to the Programme, and teachers' professional networks have expanded at all levels. Knowledge sharing and collaboration outcomes have taken place as schools have carried out CPD together, or supported one another to take forward the momentum gained through enrichment events:

"The lead at the school has supported other schools with setting enrichment up. No results to back this up yet." Oakfield Primary School

"We've established great relationships with our 3 feeder schools." Danesfield Church of England Middle School

Developing more engaging curricula has also led to increased dialogue between primary and secondary schools. For example:

"We are talking with federated schools about Year 7 transition. KS coordinators created a scheme – involving the primaries and we made it more challenging and aspirational than before. For example, before we were covering particles at KS3, but now include atomic structure as well which helps when they move into KS4. We divided the planning work and used OneDrive, so it is a shared resource across schools. Haydock High School

Key points

Reported outcomes at school or cross-department level included applying new knowledge (as in types of enquiry), and the transfer of skills - e.g. in assessment, or practical tips to benefit the department as a whole.

Qualitative feedback affirms that the awareness and profile of STEM within schools has sometimes been increased as a result of the Programme. Often driven by a passionate STEM leader, Science-based achievements (for example reaching the finals of the National Big Bang Fair) have increased the profile of the participants and STEM subjects generally at school level.

Examples of actual increased take up of STEM subjects were few at this stage (and the focus for the full evaluation), although there were more reports of positive intention to take up STEM subjects (often as a result of positive enrichment experiences. Local communities, beginning with parents, have also seen outcomes as a result of Aspire to STEM. Events have created interest from parents (evidenced from their feedback or the numbers attending events. Schools have also benefited from this increase in STEM capital, as it has improved their reputation.

Reported outcomes for Partnership schools collaborating more effectively together included, developing relationships, building trust and professional networks, sharing knowledge (both inside and outside the partnerships), and reciprocating the hosting of training. It is apparent that within Partnerships, one school has taken more of a lead role, for example using STEM Learning Centre training to in turn deliver training to other colleagues.

Outcomes for leaders were fairly equally reported by primary and secondary schools, and from cohorts 1 and 2. The schools that reported the most leadership outcomes either remained at the same Ofsted level, or had not been inspected.

Improved leadership in STEM subject areas have been observed in subject leaders either early in their career or those starting at a new school. Cross-curricular connections have been made by some teachers, including specialists and non-specialists so that a STEM subject does not sit in isolation, and opportunities are taken to include Science in other areas of the curriculum. Improving leadership to support the teaching of STEM subjects has focussed on developing the skills of middle managers and using these individuals as the conduits to raising the profile of STEM among senior leaders and in the school as a whole.

7.2 Developing teacher pedagogy within STEM subjects to support disadvantaged students

The quality of STEM teaching is considered by schools to have developed over the course of the Aspire to STEM Programme in each of a sample of 7 schools reviewed in depth for this study, and given the high incidence of outcomes for this outcome from wider mapping of a further 22 schools, is likely to have happened across a good proportion of the schools.

Quality of STEM teaching	5 schools progressed from 'beginning' and 2 schools matured from 'early progress. By Programme-end, 4 of the 7 schools were at the 'results' stage or higher.

Subject-specific teacher CPD has been very positively received. Feedback captured at the end of training sessions shows consistently strong feedback with 99% rating their CPD to be 'very good' (69%) or 'good' (30%).[24]

> *"The most rewarding thing for me was how staff engaged and enjoyed the training, this all comes down to the effective delivery and interesting practical tasks. They taught staff that new Science learning can happen at all ages. Bilston C of E Primary School*

The selection of schools and geographies to take part in the Aspire to STEM Programme created the pre-conditions whereby greater numbers of disadvantaged students were able to benefit (indirectly) as a result of more engaging teaching of the subject curriculum (including references to STEM industry contexts and careers).

> *"Another improvement is looking at Science and STEM in a careers context, so we can add in anecdotes / connections to careers." Ellesmere Park High School.*

Further analysis of the outcomes observed in schools shows that outcomes for disadvantaged pupils were most often seen in Scunthorpe and Blackpool.

Examples were found of improved subject differentiation as a result of training.[25] With delivery to support both lower attaining students (Grades 1-3) and their peers requiring more stretch and challenge (Grades 8-9), although the majority of outcomes were applicable to all.

> *"As part of the annual Science conference we delivered a session on supporting disadvantaged students, and improving their Science literacy skills. In one school there was a concentrated focus on the 1-3 agenda. The feedback from the training was very good. Without ATS it would have been more diluted, with less collaboration." Educational Lead (Blackpool)*

The 'fingerprints' of Aspire to STEM can be observed in a secondary school Ofsted report from May 2019 which states:

> *'Teaching has improved in subjects with historically weak outcomes, such as science, the humanities and modern foreign languages. In these subjects, teachers are catering more effectively for the needs of different groups of pupils.' (Sutton Academy)*

Outcomes

Outcomes were reported for each of the aspects of pedagogy (teaching styles, theory, feedback and assessment), with practical, 'real-life' examples more commonly reported than theoretical outcomes. The most commonly reported outcome across the sample of journeys reviewed was the use of new subject and pedagogical knowledge skills and understanding. The majority of these outcomes were cognitive (knowledge) based; for example, receiving new ideas (about teaching styles or content), increased subject knowledge (relevant to all STEM teachers, but arguably even more so to non-subject specialists) or receiving constructive feedback from the Educational Lead.

> *"The teachers were even using the presentation tips they were given. They seemed more confident and enthused. The lessons were a lot more interesting than before, with more practical and less recorded work. The recorded work is now about their learning rather than 'proof' of what they have done." Parklea Primary School*

Pedagogical outcomes related were supported by improved teacher confidence and motivation. Whether as a result of having permission to complete CPD and connect or re-connect with their interest in the subject, teachers both self-reported and were observed to be more engaged and secure in their delivery, suggestive of increased competence.

> *"A recent whole school learning walk showed that the teachers were more enthused in lessons, delivery was more engaging than before, and the children were responding positively to this. Teaching has definitely improved." Parklea Primary School*

At a more general level, Ofsted inspectors have sometimes remarked on the difference that professional development has made:

> *"The professional development of staff has been highly effective in improving the quality and consistency of teaching and pupils' behaviour." Merrill Academy*

These outcomes were mainly affective, affirming, or re-affirming their career choice and re-energising departments that had been under-performing and lacking in confidence. This increased enthusiasm and confidence was manifested in a number of ways; for example, attending extra training or creating activities for Science Week – in turn reaching greater numbers of students.

"Knowledge sharing among peers was valued." Halewood Academy

> *"Working scientifically CPD has been a notable success across all schools with a real culture change, moving away from worksheet delivery to some novel and exciting practical investigations: 'Which sneeze travelled the furthest?' and 'The volcano experiment' being among the most memorable! [4 Scunthorpe primary schools)*

The delivery of teaching was also aided by improved technical skills; for example, delivering practical sessions. Improved technician skills were highlighted, with a network created by the North Midland Science Learning Partnership.

> *"Technicians are now adopting techniques that they were previously unfamiliar with as a result of the network meetings. I measure the success by the number of practical set ups I haven't seen before as these provide a new/different way of providing an experiment that may be easier to set up, cheaper to set up or a more engaging way for the pupils to learn." The Discovery Academy*

Outcomes linked to feedback and assessment included improved knowledge and understanding of areas of relevant STEM subject curriculum was gaining wider subject knowledge for primary teachers.

> *"The Year 6 teacher said teacher assessment at the end of Key Stage 2 is more informed" Althorpe and Keadby Primary School*

Another commonly reported measure of success in the action plans was improved Schemes of Work. While independent assessment has not been possible, teachers did self-report that their lesson planning and content has been improved as a result of the inputs received from the Programme.

Albeit based on a small sample, primary schools reported, on average, double the number of outcomes for teachers than their secondary colleagues.

The Programme has enabled more staff to take part in CPD directly, resulting in a more direct learning experience that may result in amplified outcomes.

> *"Has enabled school to add challenge and drama into lessons - and so even greater pupil engagement." Althorpe and Keadby Primary School*

CPD for STEM teachers was seen to have been developed from a low starting point 'beginning' to at least early progress and for 4 of the schools, towards a 'results' phase where there is evidence of achievement, and for 2 starting to see results more consistently.

There were divergent views obtained about the use of the resources facilitated and signposted by the STEM Learning Centre. Over half (56%) of those attending CPD said they had not yet used them. Of those that had (n=742), 73% found them 'quite useful' or 'very useful', while 27% considered them of 'little use' or 'not at all useful'.[26]

Notes and learning resources gathered as a result of CPD were being used, shared and applied in school. Access to the wealth of online material has been hampered by capacity issues, but improved through the links made by the Educational Leads.

A challenge in each of the six Partnership areas assessed in detail was high staff turnover and the extensive requirement to use supply teachers. It was not in the scope of the evaluation to review school retention figures, but key contacts interviewed and Educational Leads agreed that the Programme has made a positive contribution to the stability of teams (both subject leaders and staff), starting with the head of department. There was one example provided of schools becoming more attractive to applicants. In the example below, school in question is one that 'requires improvement'.

> *"Department staffing is settled now. We have recruited a new second in Science and a Science teacher starting in September. One person went for the deputy position and came second, then re-applied for the Science teacher. She told us she really wanted to work in this department, so was willing to take the Science teacher role." Haydock High School*

Outcomes for staff teams are not uniform, and it was noted that departments that have engaged less (either by choice or capacity issues) were seen to have matured to a lesser extent over the Programme. In relation to subject leadership:

"Science were most engaged [the lead contact was also Science lead], and they are now at a mature stage of subject leadership, Maths less so, but they are showing early progress." (Haydock High School).

Key Points

Outcomes were reported for each of the aspects of pedagogy, with practical, 'real-life' examples more commonly reported than theoretical outcomes.

The most commonly reported outcome across the sample of journeys reviewed was the application and use of new subject and pedagogical knowledge, skills and understanding. Inspired by the CPD they had taken part in, teachers were able to implement some or all of what they had learnt.

The Programme's structure, and local delivery elements, enabled greater numbers of staff to have a direct experience of CPD, which aided the subsequent application of knowledge.

There was no clear pattern of schools who were more or less likely to report pedagogical outcomes, with a range of areas and both primary and secondary schools represented.

The range of tailored CPD has been connected to STEM teachers and leaders with an appetite to develop and improve; not only their own skills, but those of their colleagues.

A sentiment expressed on a few occasions during the depth interviews was that STEM subjects were less likely to receive attention and funding compared to English and Mathematics. One Educational Lead stated that the new Ofsted framework compounded rather than improved the situation. Aspire to STEM has started to redress this (perceived or actual) imbalance.

7.3 Increasing science capital within disadvantaged communities (including enrichment to raise awareness of STEM)

Schools reported developed maturity in delivering STEM enrichment as a result of Aspire to STEM and to a lesser extent, improved STEM careers education. The communities chosen to take part in the Programme are all disadvantaged, but differ in many respects. Schools in Cumbria and West Somerset for example face additional barriers accessing enrichment events owing to their rurality. Other areas, St Helens for instance, do not have significant STEM employers in their local area.

STEM enrichment	6 schools matured from a 'beginning' point, and by the end of Programme, all 7 were at the 'results' stage or higher.

Of the 8 aspects of Science capital[27], the case studies and primary research have found examples relating mainly to:

- Science literacy
- Knowledge
- Participation in and out of school learning activities
- Knowledge about the transferability of Science.

Less commonly reported were:

- Talking to others about Science
- Knowing people in a Science related job / role.
- Family Science skills.

Increased Science capital has been reported across Partnerships as a result of enrichment events led by The Royal Institute in particular.

> *"They were amazing. We got them in to raise the STEM profile with pupils. I can't say enough positive things about it. They were so organised; we simply provided the space and a table! He got the children completely captivated (but he was able to control them too) and got all the teachers involved. As it was all about the body, there was poo involved which the children loved." (Downs Barn School)*

Schools have also benefited from this increase in STEM capital, as it has improved their reputation in the eyes of the local community (particularly future prospective parents).

> *"The day was absolutely amazing – it was a delight to see so many of our pupils asking questions about careers in healthcare. This has definitely switched them onto the opportunities that are available" Willoughby Road Primary Academy*

> *"Parents have come up to me and other teachers and talked about what activities they can do at home because they learnt from the Parent Show that they don't have to go out and buy expensive equipment." Parklea Primary School*

Students have increased their enthusiasm and have felt inspired.

> *"Pupil voice shows a more positive engagement with Science." Prescot School*

Example outcomes for improved student progress, skills or understanding in STEM included gains in Science literacy. Other outcomes for students related to aspects of STEM capital -

awareness of STEM and raised aspirations – considered to be particularly necessary in areas of multiple disadvantage.

> *"I think of better questions because I have a question band." Y4 student Althorpe and Keadby Primary School*

There were a number of outcomes where specific reference was made to vulnerable students or to girls – with striking examples that suggest the outcomes may be sustainable. STEM clubs and (to a lesser extent) activities featuring STEM ambassadors have made a positive impression on students across the schools represented.

> *"Raising aspirations is absolutely our role. Young people in this area are sometimes disadvantaged and lack role models." Haydock Park High School*

Activities are sometimes aimed at more disadvantaged children and families, but equally open to all and not 'by invite only' or just for the highest achievers.

> *"As a school we are big on clubs that are free and accessible. Increasing teacher confidence was something identified for the school as a whole." Oakfield Primary School*

While students' enthusiasm, engagement and motivation were the most frequently mentioned, together with (and likely connected) improved progress in STEM subject skills, knowledge and understanding, reports of improved attainment were fewer, but notable. Examples included improved performance in mock exams, or for cohort 1 schools, noting improved GCSE grades as part of a wider school pattern.

> *'Improved Science GCSE results for the students that took part. For Example, a student with a 44 target went on the gain a 55 following their attendance at Operating Theatre Live.' Irlam and Cadishead College*

> *'The working scientifically elements of Science within our online assessment system are showing increased levels of children achieving age related expectations. However, this data will not be finalised until the end of the academic year.' Bilston C of E Primary School*

In one school, there was a clear link between an observed priority to increase student uptake of triple Science, CPD to support this, and a significant increase in actual take up of the subject. This is an isolated example, and the attribution of this Programme to uptake and STEM exam performance will be considered once the full evidence base is in place.

> *'Althorpe and Keadby also set up their own STEM club and made use of a CPD course on 'Crumble Robotics' to provide a theme for their projects around the development of wind power turbines. This was linked to a local employer that maintains wind farms in the area. Pupils were tasked with building prototype wind farm models and working with their parents to investigate and refine the design to generate the maximum amount of electricity. The models produced were stunning and it's no exaggeration to say that much of the Science wouldn't look out of place in a KS4 classroom.' Termly Educational Lead report*

Key Points

Of the 8 aspects of Science capital, the case studies and primary research have found examples relating mainly to Science literacy, knowledge, participation in and out of school learning activities and knowledge about the transferability of Science.

Increased Science capital has been reported across Partnerships as a result of enrichment events led by The Royal Institute in particular.

Outcomes for students were mainly affective, increased enthusiasm, engagement and (re) inspiration. Other outcomes for students related to aspects of STEM capital - awareness of STEM and raised aspirations – considered to be particularly necessary in areas of multiple disadvantage.

STEM clubs and (to a lesser extent) activities featuring STEM ambassadors have made a positive impression on students across the schools represented.

Schools in Scunthorpe, St Helen's and West Somerset were more likely to report outcomes for pupils. It is interesting that 2 of the 3 schools where the greatest number of outcomes for pupils was observed also carried out more CPD.

Enrichment events were reaching parents from across diverse communities, but the extent of existing Science capital is not known by the schools involved.

The different facets of Science Capital were being raised as a result of the Programme's multiple interventions; with teachers making a clear link between relevant, bespoke CPD, and gains in students' Science literacy, while resources and the expert support of the Educational Leads was generating increased enrichment which was then being discussed in the classroom and at home.

While the CPD and resources are not specific to disadvantaged communities or designated Opportunity Areas, the geography, and particularly the nature of the local labour markets may support or hinder future attempts to strengthen links between schools and STEM employers.

7.4 Strengthening careers information and guidance (particularly technical pathways)

STEM careers education was the least mature at the beginning of the AtS Programme, and had developed least of all of the outcomes reported.

STEM careers education	5 schools matured from 'beginning'. By Programme-end, 1 remained at this stage, 3 were at 'early progress' and 3 at 'results' or higher.

As we have seen, the ability to link STEM subject teaching into real world contexts (ideally rooted in the local area), was an outcome that was being reported by teachers from the sample of partnerships reviewed. The needs analysis process regularly identified careers information and guidance as the weakest aspect of provision as the Programme began.

> *"It would be great to increase our connections outside the school and develop the careers side. As a priority it is perhaps 1 to 2 years away. Our focus first is on subject leadership and teaching." Oakfield Primary School*

Parent engagement represents a small proportion of outcomes overall but contains some striking examples of where STEM related events have drawn in parents from diverse backgrounds and started a conversation with the school about Science that was previously absent. These schools would all like to repeat or develop this activity for future year groups and parents.

One school reported that parents were glad to have Science homework as it made a refreshing change from literacy and numeracy. Although low in number (outcomes relating to parents account of there were examples of parents wanting to opt into STEM activities on the basis of positive word of mouth recommendations, or using little / no cost materials at home to recreate practicals seen delivered by the Royal Society.

STEM enrichment, typically centred on STEM clubs and events, have seen consistently positive gains in maturity, from a beginning starting point to seeing the initial achievement of results. In turn, this is having an effect on student behaviour.

> *"Many children have asked for a Makey Makey for Christmas- this shows they have been inspired by the learning that they have done! (incredible!)" Willen Primary*

> 'This school were very keen on space as a focus for their STEM Club activity and *made use of the STEM Ambassador Programme to run a practical workshop for year 1 and 2 pupils on space Science. Delivered by a National Space Academy Lead Educator who acts as an ambassador to the region, the session was very well received by both pupils and staff alike with lots of ideas for practical activities and hands-on investigations!' Winterton C of E Infants*

This evaluation has not observed gains in the capacity of staff teams to deliver careers education across the sample of schools reviewed, although there have been cognitive (knowledge) outcomes, and an increased willingness to weave in careers insights into lessons. Where progress has been limited thus far, the Programme has highlighted the importance of careers education.

> *"Raising aspiration is key, it would be great for the kids to see the commercial touch. It still seems a long way off for primary school pupils." Oakfield Primary School.*

This finding may feasibly be a consequence of methodology limitations.

Key Points

STEM careers education was the least mature at the beginning of the AtS Programme in schools reviewed and was seen to have developed more slowly than the other outcomes reported.

In contrast, STEM enrichment has seen consistently positive gains in maturity, from a beginning starting point to seeing the initial achievement of results. The reputational gains to the school from arranging and hosting enrichment events may serve as an incentive to continue this stream of work.

As we have seen, the ability to link STEM subject teaching into real world contexts was seen to both enrichen classroom teaching and support the development of STEM capital. The STEM ambassadors have also served as role models in geographies where these are thin on the ground.

Parent engagement represents a small proportion of outcomes overall, but contains some striking examples of where STEM related events have drawn in parents from diverse backgrounds and started a conversation with the school about Science that was previously absent.

This evaluation has not observed gains in the capacity of staff teams to deliver careers education, although there have been cognitive and attitudinal outcomes.

There is no clear pattern in outcomes achieved by type of school, and careers education is perhaps most successful when there is a member of staff with a particular passion to drive it forward – as was the case in the Salford and West Somerset partnership areas.

Outcomes clearly linked to strengthened careers information and guidance were not uniformly reported, and were sometimes linked to engagement with national awards or competitions as part of a wider raising of the profile of STEM within schools.

The strengthening of careers education for STEM is a long-term undertaking, requiring the skilful coordination, and combined capacity, of many stakeholders to realise. The Programme has succeeded in raising awareness of STEM careers, and how connecting activities in the classroom to the workplace can raise STEM capital in students

8 Attribution and Added Value

Attributing STEM outcomes to the AtS Programme requires more advanced evaluative techniques than has been possible for this review evaluation. In an ideal situation, all 206 schools would have completed their pre- and post-Aspire to STEM subject performance self-assessment and be asked to what extent any changes in performance could be attributed to the Programme compared to other factors. Nevertheless, a number of useful insights have been gained from this evaluative process. First, it is helpful to understand the wider factors that schools have told us can effect changes in STEM profile and outcomes.

Contributors to change in STEM at schools

The following is a list of factors that appear to contribute to a change in the profile and quality of STEM learning and growth of Science capital within schools that have been reviewed in this evaluation. They are also, arguably, preconditions required within a whole school improvement context for a programme such as Aspire to STEM to really thrive too. That is to say, the more of these pre-conditions that are in place within a school, the more likely AtS interventions are going to have the chance of being embedded post-intervention:

- A new head teacher / leadership to drive improvement across the school.
- A pre-existing focus by the school to develop leadership, including middle leaders and subject leaders.
- The backing of the Senior Leadership Team for STEM subjects and enrichment.
- Stabilised teams / less turnover of teaching staff / STEM leaders rebuilding their team or recovering from crisis whilst having a clear desire to improve and raise standards.
- A more defined culture of CPD within the school.
- The new Ofsted framework and new curricula thought to be driving up quality of teaching and learning.
- A focus on support for new STEM leads / teachers so that when programmes such as AtS arrive they are embraced as part of that supportive continuum.
- An effective and supportive Trust that is keen for all schools in its network can help to propagate STEM learning in one of its school to the others.
- An emerging or pre-existing desire within the school to engage with its local community, family and parents.
- A heritage and / or desire to offer a range of after school clubs and activities.
- An attractive vocational curriculum offer which opens up the opportunity for STEM subjects including Engineering.
- Schools that have a ‘presumption’ towards or prioritise pupil’s learning of technology.
- Good use of funding designed to help schools narrow the gap between disadvantaged students and their peers.
- A school that is determined to raise aspirations, not only offering effective careers IAG but offering trips to universities and having good links with STEM employers.

A review of 6 schools using their Ofsted documentation only (see next table) reinforces some of these contributing factors including: the role of an inspiring Science subject leader; a supportive Trust that provided subject specialist support to the school; a pre-existing school improvement plan focus on raising aspirations; a school with a focus on stretching and challenging pupils responding to their inspection critique; and the offer of a broader vocational curriculum including STEM subjects. When thinking therefore about the extent to which any changes in STEM can be attributed to Aspire to STEM, it would be appropriate to consider these factors.

Table 12: Example school contexts and changes in STEM during the intervention period

Case	Pre-AtS inspection report	Since commencing AtS inspection report	Factors thought to contribute to changes in STEM
1	This school was rated '3' and the main criticism was around leadership. Mathematics was performing on par with national averages, but Science was not; being described as lacking challenge and making slow progress.	Two years later, still rated '3' Science was now being praised for introduction of the department's bronze, silver and gold strategy to support and challenge pupils. Pupils in Science were achieving well. KS3 progress in Mathematics was criticised.	Subject leaders had received training and external support to ensure the accurate assessment and moderation of pupil's work as part of a wider school approach to improve the quality of teaching and lift ambition. Science department strategy and subject leadership.
2	This school was rated '4' and disruptive pupil behaviour limited school progress in all areas. Mathematics had some strong leadership practice, but outcomes in the subject, along with Science (and teaching quality) were poor.	Still requiring special measures 3 years on. Despite subject leaders new in post at the last inspection for Science and Mathematics their ambitions to deliver high quality lessons were undermined by time spent managing day-to-day poor pupil behaviour.	No improvements noted in STEM nor school more generally. The Mathematics subject lead was promoted to head teacher and the green shoots of their prior subject leadership have not grown. Lack of effective coaching and training was cited as a constraint.
3	This school was rated '4' with weaknesses across leadership, teaching quality and pupil outcomes. There was some strength noted in careers IAG for sixth form students.	2 ½ years later the school was rated '2' (good); a turnaround story with good pupil outcomes emerging in Science and Mathematics by the end of KS4 expected to continue upwards. Engineering had been added to the vocational curriculum and student placements strengthened 'careers'.	Determined leadership embedding a positive and inclusive culture. Professional development of staff cited as being highly effective to improve quality and consistency of teaching and pupils' behaviour. Good use of funding to narrow gap between disadvantaged pupils and peers. Broader, attractive vocational curriculum including STEM.
4	This school was rated '3', however, the report was upbeat suggesting a rise in standards, outcomes, improvements in the teaching of Mathematics and praise for careers IAG, industry links and a project to encourage girls to consider engineering.	3 years later the school improved to a '2' (good) with praise for leadership, more opportunities for pupils to be challenged and some deficits in Science being addressed through support for subject leaders. A Science club was cited as an example of strength in this school and trips to universities were raising aspirations.	The 'infectious commitment of the head teacher'. Opportunities to apply numeracy skills learned in Mathematics to subjects like Science. The Academy's sponsor was praised for effective support and challenge to the school including specialist subject advice support by the various subject directors. Use of subject experts from within and beyond the Trust.
5	This school was rated '4' for leadership, management, pupil outcomes and teaching quality. Mathematics, Science, IT and Computing were seeing slow progress especially amongst disadvantaged pupils. Careers IAG was a strength at sixth form.	18 months later the school had improved to a '3' but teaching was still inconsistent and there was insufficient pupil challenge. Pupils in Mathematics and Science were mot making consistently good progress particularly in Years 9 and 10.	No changes observed in STEM for this school, inconsistencies in teaching quality appear to persist.
6	This school was rated '3' overall with leadership deficits at middle management. Science and Mathematics were praised for a rise in standards and progress that was expected to continue. The teaching of Technology was an established strength.	Improvements to the teaching of Science were described as dramatic and throughout the school. Science teachers had high expectations and routinely challenged pupils of different abilities. They used experiments to bring Science to life and enhanced the pupils' scientific skills. These improvements had already brought about a transformation in pupils' achievement by the end of Year 11.	A new leader in Science was cited by inspectors as raising standards in the subject. A whole school focus on narrowing the performance gap between disadvantaged students and their peers. Leaders' prioritisation of pupils' learning in Technology, the option to study vocational courses, strong careers IAG and links to the local labour market. Methodical careers education with parental engagement.

AtS contribution to STEM change within schools

In total, 184 outcomes were observed across 29 schools.[28] Overall, 78 of these outcomes (42%) were recorded from the totality of evidence gathered for 7 schools that were examined in greater depth.[29] These depth journeys included an assessment of the school's maturity linked to the Programme aims. Schools were asked to consider where their Aspire to journey began and, with the Programme's support, where it concluded using the following 5-point scale.[30]

Level of STEM maturity	**1. Beginning** *Principle accepted and commitment to action*	**2. Early progress** *Early progress in development*	**3. Results** *Initial achievements evidence*	**4. Maturity** *Results consistently achieved*	**5. Exemplar** *Other schools learning from our consistent achievements*

Encouragingly, all aspects have shown an increase in maturity, a consequence of the 'improved focus on Science' for participating schools. The results show that on average, these 7 schools progressed on average by 1.6 stages, with a modal shift in maturity of 2. There was variation in the extent to which progress was observed, with CPD for STEM teachers showing greatest gain, and STEM careers education the least.

Table 13: Changes in STEM maturity within 7 case study schools

Aspect of maturity	**Average Change (+)**	**Typical response[31]**
CPD for STEM teachers	2.1	From 'beginning' or 'early progress' to 'results' or better.
STEM enrichment	2	From 'beginning' to 'results'
Collaboration with other schools	1.6	From 'beginning' to 'results'
Quality of STEM teaching	1.4	From 'beginning' or 'early progress' to 'early progress or 'results'
Quality of subject leadership	1.4	From 'beginning' to 'early progress' or from 'results' to 'maturity'.
STEM careers education	1.1	From 'beginning' to 'early progress'
Overall	1.6	From 'early progress' to 'results'

N=7 schools.

It would appear that the Programme's ostensible focus on CPD and enrichment has resulted in the greatest gains being registered here. There is a perhaps a temporal element to the findings with greatest gains being registered for activities that can be achieved in the short term i.e. taking part in CPD or hosting events. There is also a link between the STEM priorities captured at the start for these schools and where maturity was greatest.

Whereas progress has been slower towards behavioural outcomes that could result in improved quality. Quality of teaching and subject leadership were also starting from a more

advanced stage, overall, compared with enrichment and STEM careers education, which may be a factor in the slower maturity for these latter domains. It should also be observed that, in a purist sense, the later stages of the maturity grid can only be achieved over a longer period of time, as results need to be consistently achieved.

As noted above while there is an appetite to connect classroom to workplace, there are longstanding capacity-related and cultural barriers to overcome to embed this at school level. As a rule, STEM careers does not command the same attention as teaching outcomes in schools. Research from 2015 (updated in 2018) showed that CPD accounts for less than 1% of total school turnover. There was significant variation by area on the CPD budgets available to support staff, from £165 per staff member per year to over £1,000.[32] The average was in the region of £400. Budgets have fallen, on average, by 12% since 2016, despite widely reported recruitment and retention challenges.[12]

It is in this context that the Aspire to STEM Programme has invested £1 million in 2016 schools across 206 schools in 40 Partnerships engaging at least 2,802 individuals - equivalent to a budget of £356 per teacher over a 2-year period. In this context therefore Aspire to STEM will have been viewed as a significant financial boost for schools.

Educational Leads report that the majority of CPD is directed towards English and Mathematics, then to more significant (in terms of student numbers) STEM subject areas. Analysis of Programme engagement data shows that 54% of all CPD was related to Science, compared with (for example) 4% for physics, 7% in Computing Science and 3% in Mathematics and Design Technology.[33]

The extent of STEM change contributed by AtS could be missed

One secondary school was able to provide an assessment of STEM subject performance pre and post Programme, the only school to have done so is the evaluators' understanding. This is potentially a missed opportunity as the results are more illuminating than their Ofsted report or hard data alone. At the start of their AtS journey, 15 out 16 subject performance criteria (94%) were rated by the school as '3' (requires improvement) or '4' (inadequate). In contrast, by March 2020, 13 of 16 criteria were self-assessed as '1' or outstanding and none rated a 3 or a 4. All STEM subjects have improved their performance since AtS engagement.

Table 14: Haydock School pre- and post-AtS STEM subject performance criteria

	Science		**D&T**		**Mathematics**		**Computer Science**		**Engineering**		**STEM Mean Score**	
	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
Quality of teaching	3	1	2	1	3	1	3	1	2	1	2.6	1
Pupil Learning	4	2	3	1	3	1	3	1	3	1	3.2	1.2
Quality of subject leading	2	1	2	1	3	2	3	1	2	1	2.4	1.2
STEM Careers education	4	2	4	2	4	2	4	2	4	2	4	2
Subject Mean Score	3.25	1.5	2.75	1.25	3.25	1.5	3.25	1.25	2.75	1.25	3.05	1.35

[12] Future programmes may wish to consider capturing the CPD spend in STEM subjects as part of the baseline development.

The attribution of support to develop STEM leadership is less clear. Ofsted reports describe how schools are investing in middle leaders to drive improvement in teaching and therefore attainment. Educational Leads report that senior teams in Opportunity Area schools have many initiatives to manage, which likely reduces the focus (and therefore impact) of any one Programme on this audience.

At subject leadership level, qualitative feedback does show added value from the Programme. The bespoke content, and the culture of learning in place at the STEM Learning Centre in York, was seen to complement and build on previous middle manager training.

Table 15: Counterfactual speculation

School	Counterfactual
1 (S)	*"The project has helped us to achieve outcomes more quickly and more effectively than would have happened if we had not engaged."* The leadership of the Head of Science, and the willingness and efforts of the teaching staff have also been important contributory factors, but funding has opened up opportunities that would have been unlikely to have been taken up without that support. The funding has made a real difference to the school's ability to offer appropriate training, which has supported an increase in CPD among STEM staff.
2 (M)	Finance has been the critical factor, without it, these events would not have taken place.
3 (S)	Funding has been a key factor in the outcomes reported. *"We would have really struggled – the vouchers etc. made all the difference. Victoria did a really good job at getting us to think as a network and share training to make the best use of the budget."* The Programme increased the extent to which the school could engage with enrichment events. *"The Programme contributed £250 towards the project, and without finances for extracurricular activities like this one are difficult to secure. This went towards the transport for the girls to attend the event."*
4 (S)	The school notes that there has been added value to taking part in AtS, building on, rather than duplicating what was already taking place. *"We'd still have trained, but not to the same extent, or in the same way with other schools."*
5 (S)	*"We knew that we needed to improve on our grades. It has been about gaining new ideas and I don't know how we could have accessed this without [AtS]. We couldn't afford external training."*
6	*"I am not convinced we would have done this [without the Programme] to be honest. I am proactive, but this wouldn't have got me to the same places, and in turn I can help other teachers with their planning. I'm using the course notes regularly and have a clear memory of the CPD."*
7	The school considers that the CPD and enrichment received would not have taken place without the Programme, as funding is very limited. *"Were it not for the money this wouldn't have happened. This has opened so many doors for us. The Royal Institute was immediately valuable, but the CPD too, whilst not as immediate, will last."*

The seven schools studied in detail for this review affirmed strongly, that without this Programme, the CPD delivered would most likely not have happened at all, or to a much-reduced extent in the same timeframe, and to far fewer staff members. The requirement that spending was only for CPD, rather than other items like equipment also increased the take up.

> *"The project has helped us to achieve outcomes more quickly and more effectively than would have happened if we had not engaged."*

The funding was the decisive factor, opened up opportunities that would have been unlikely to have been taken up otherwise. The funding has made a real difference to being able to offer bespoke and appropriate training.

> *"We would have really struggled – the vouchers etc. made all the difference. [The Educational Lead] did a really good job at getting us to think as a network and share training to make the best use of the budget."*

It is observed that there has been resistance in the past to accepting support from the local authority, which is in contrast to the engagement seen in the St Helen's AtS Partnership.[34]

Other contributing factors were the leadership qualities of the STEM lead, the degree of autonomy granted STEM departments by the school to take part, and the degree to which staff were aware and bought into the Programme.

Another secondary school highlights the wider benefits from the Programme, against a backdrop of 'very limited' funding.

> *"Were it not for the money this wouldn't have happened. This has opened so many doors for us. The Royal Institute was immediately valuable, but the CPD too, not as immediate perhaps, but it will last."*

In one school (and the exception rather than the norm) the improvement in Science teaching was highlighted by the May 2019 Ofsted report, which is significantly connected to AtS support.

> *"Teaching has improved in subjects with historically weak outcomes, such as Science, the humanities and modern foreign languages. In these subjects, teachers are catering more effectively for the needs of different groups of pupils." (Ofsted report May 2019)*

In this school, subject specific CPD was particularly valued. In addition, the Programme was a contributing factor in the Big Bang success enjoyed by a group of Year 10 (now Year 11) girls by offering support to broaden the outcomes to a wider group of students.

Another school, rated good overall by Ofsted, noted that there has been added value to taking part in AtS, building on, rather than duplicating what was already taking place.

> *"We'd still have trained, but not to the same extent, or in the same way with other schools."*

The added value of the Aspire to STEM Programme

A review of teacher feedback following their CPD encounter(s) suggest that the Programme has added value for some of them, either because it was the only STEM CPD they had received, or because it differed from other CPD they had experienced before.

> *"The expertise was invaluable."*

The way in which the CPD provided practical examples was especially appreciated:

> *"Being shown examples rather than coming up with our own, unlike most CPD."*
> *"I had never had Science CPD before so any new ideas were useful! Examples were very useful to look at."*

For other teachers, it was the way in which the AtS CPD aligned to the National Curriculum, but in a more compelling or practical way:

> *"Do-able ideas, relevant to the National Curriculum, but so more interesting."*

Various novel elements were identified too from taking part in the CPD:

> *"The CPD has given me new strategies to try."*
> *"New ideas to take to the department."*

Finally, the AtS CPD, for some, provided an opportunity to see STEM from other people's viewpoints, challenging their own practice and ways of teaching the subject(s).

> *"The session 'standing on shoulders of giants' provided a new perspective."*
> *"The interactive aspect was useful, taking part in activity that the children would do proved useful for developing my own activities."*

This last point is interesting as it suggests that the CPD helped some teachers to be more empathetic by experiencing activities as the children would in their classes. A review of school journeys found a number of areas reported by their key contacts and Educational Leads as having added value within the context of their whole school improvement plan including:

- The encouragement of greater levels of STEM collaboration with local schools than might otherwise have happened.
- The acceleration of inspirational community activity.
- New or recent STEM subject leads in particular appearing to get a boost from the AtS support to help them have the confidence and tools to improve the profile – especially of Science – in their school. In some cases, the subject lead has created a new direction for the subject and achieved greater levels of SLT and peer support across the school.
- Cross-curricular connections have been made by some teachers, including specialists and non-specialists so that a STEM subject does not sit in isolation.
- The Programme has afforded some novel investment in activities not tried before such as STEM community events and enrichment (typically Science-related shows - that has inspired children and their families alike); and / or deeper CPD such as a 3 day residential for members of staff never afforded before.
- STEM Leaders enjoy improved connections with neighbouring schools often with little or no legacy of working together prior to the Programme, and teachers' professional networks have expanded at all levels.

The Programme has increased the flow of new ideas into schools.

> *"The money to spend was a pleasant shock to get better…We knew we needed to improve on our grades. Aspire to STEM for us has been about gaining new ideas. I don't know how we could have accessed these without the Programme. I know we couldn't afford external training." All Saints Catholic High School*

Furthermore, some teachers observe that the sum of their CPD has enabled them to be more empathetic with their pupils and their relative abilities and progress.

Disadvantaged students

The term 'disadvantaged student' was not used by any teachers in their feedback, rather, they would comment on how the CPD made them think about how to encourage better outcomes for different types of student through their teaching, by making it more fun, engaging, personal and challenging with appropriate cross-curricular connections.

> *"I found the CPD discussion useful about how to enthuse students working at 1 – 3. Reflection about research showing that streaming is best for student achievement was useful too."*

One teacher talked about the pace of their teaching:

> *"Information about slowing down lessons and trying not to cover everything in one lesson and focus on small parts in detail was useful."*

A number of teachers made comments about how Science CPD in particular had made them think about how to make their teaching less prescriptive to engage students more:

> *"Interesting ideas about how to allow children freedom with a set experiment was useful."*

Some reflected on how to more generally support students make STEM subjects more accessible where they were struggling with other aspects of their learning:

> *"Maths and Science - how to focus on science for children where literacy gets in the way."*

Other considered that the CPD had been useful in the way it helped them think about how to tackle particular students in their learning pathway and challenge them appropriately to progress in their learning:

> *"All the activities were relevant to specific year groups."*

> *"The challenge to review Key Stage 3 practical work. How to expand students thinking."*

9 Conclusions

The Aspire to STEM Programme has recruited more participants than expected and has delivered a minimum of 9,000 CPD hours across over 10,000 incidences of learning and activities since September 2017 to teachers and leaders in 206 primary and secondary schools across 40 Delivery Partnerships. It has sought to support schools identify, and then address STEM priorities in their whole school improvement plans, through a mix of practical, financial, expert and flexible support over a 2-year period.

Teacher pedagogy within STEM subjects to support students has been the most prevalent outcome of the Programme. Teacher feedback confirms the CPD's usefulness in helping them use different approaches to narrow the gap between students who were struggling and their peers. Almost all teachers reported that they had developed and used skills, knowledge and understanding in highly practical and engaging ways in their classrooms, and sometimes outdoor environments as well, as a result of their Aspire to STEM experience.

The evidence points to teachers gaining wider subject knowledge, improved schemes of work, improved quality of teaching and an expansion of professional networks and a mind-set of collaboration with others. The other commonly reported outcome across the schools for teachers was improved enthusiasm and confidence. This increased motivation manifested in a number of ways; for example, teachers choosing to attend extra training or creating activities for Science Week.

Teachers are confident that their CPD is impacting on their teaching practice and therefore impacts on the students who were described as; having greater enthusiasm and engagement, manifest in the form of 'amazing and thought-provoking questions' at events, greater curiosity in lessons, more interest in experiments and sustained attendance at STEM clubs. Teachers described accelerated pupil progress (for example reaching their age-related expectations) or developing new skills or understanding in STEM (for example the use and understanding of scientific language). There were a number of outcomes where specific reference was made to vulnerable students or to girls - with striking examples that suggest the outcomes may be sustainable for those young people. Activities were sometimes aimed at more disadvantaged children and families, but most appeared to be open to all and not 'by invite only' or just for the highest achievers.

Student aspirations are thought to be changing in some schools, but this assertion is made cautiously because primary data has yet to be collected from students. A more prudent claim is that schools have made use of AtS to contribute to their school improvement priority of stretching and challenging pupils – often the topic of an Ofsted inspection report demanding that teachers change their attitudes and practices in schools rated '3' or '4'. Positive examples of aspirational gains by students have been in those schools that have been able to offer a broad vocational curriculum (including subjects such as Engineering), Science clubs and/or similar enrichment, dedicated CIAG (mostly observed within sixth forms) and opportunities to visit universities and discuss STEM jobs (again mostly with older students).

Schools in Scunthorpe, St Helen's and West Somerset were more likely to report outcomes for students, and interestingly 2 of the 3 schools where the greatest number of outcomes for students were observed were the ones that had also taken part in significant amounts of AtS CPD (and the other comparatively little). While the CPD and resources were not specific to disadvantaged communities or designated Opportunity Areas, their geography, and particularly the nature of the local labour markets may support or hinder future attempts to strengthen links between schools and STEM employers.

Improving leadership to support the teaching of STEM subjects has focussed on developing the skills of middle managers and using these individuals as the conduits to raising the profile of STEM in the school as a whole. Subject leaders either early in their career or those starting at a new school were particularly reporting leadership outcomes in STEM subject areas. Participants have applied leadership and management skills in their reflective practice, curriculum knowledge, questioning and enquiry, investigation skills and implementation (e.g. subject action plans linked to the areas of the curriculum staff were responsible for). Although less frequently reported, improved use of data and assessment were also enabling some subject leaders to put in place the appropriate support needed to reduce the gap between pupil outcomes.

Cross-curricular connections have been made by leaders and teachers, so that a STEM subject does not sit in isolation, and opportunities are taken to include Science in other areas of the curriculum. Reported outcomes at school or cross-department level included applying new knowledge (as in types of enquiry), and the transfer of skills - e.g. in assessment, or practical tips - to benefit the department as a whole. Teachers reported increased awareness of different styles of leadership, strategies and how to deploy them. New subject leaders were imbibed and enthused with the culture of learning and development they accessed through the STEM Learning Centre.

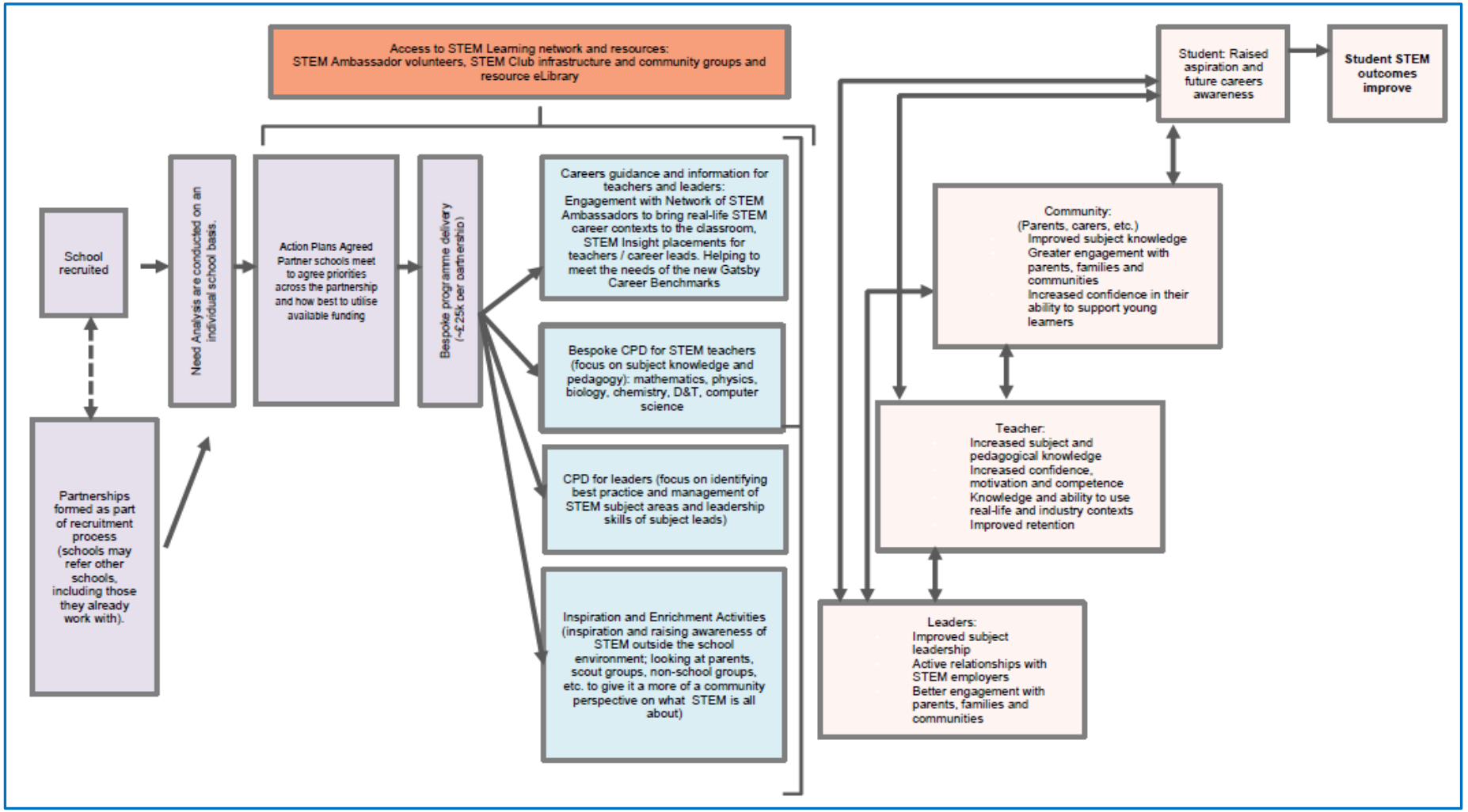
Qualitative feedback affirms that the **awareness and profile of STEM within schools** has sometimes been increased as a result of the Programme. Often driven by a passionate STEM leader and/ or science-based achievements (for example reaching the finals of the National Big Bang Fair) increased the profile of the participants and STEM subjects generally at school level. Examples of actual increased take up of STEM subjects were few at this stage (and the focus for the full evaluation), although there were examples of positive intention to take up STEM subjects. The extent to which teachers, more generally across the sample, feel confident to provide STEM careers information and guidance is as yet undetermined and more work is expected for this to happen and endure in each school.

79 community events have been delivered during the lifetime of the Programme and where they have attended, parents as well as their child/ren have had an opportunity to learn together and feel inspired. 5 out of 8 defined **Science capital** ingredients have been observed in this review with teachers making a clear link between relevant, bespoke CPD, and gains in students' Science literacy, while resources and the expert support of the Educational Leads was generating increased enrichment which was then being discussed in the classroom and at home.

Concluding Remark

Taken together the sampled evidence included in this review suggests that participants in schools have found the Aspire to STEM Programme to have been of high quality, relevant, useful, customised to their needs, helpful to improve their practice and leadership and has added value in ways that would not have otherwise happened at all or to the same extent in the same time period. In short, it has been a catalyst for schools that are relatively immature in their STEM journey and an accelerant for those schools that have more mature STEM assets on which to build. Intermediary outcomes have emerged that have the potential to impact on student progress, attainment and teacher retention and this will be the subject of the final assessment in 2020/21. In the meantime, there is opportunity to learn many lessons from the Programme's processes to better understand the non-uniformity of outcomes illuminated in this study.

Appendix 1: Aspire to STEM intervention logic model[13]



[13] Source: RAND study plan. https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/aspire-to-stem/

Appendix 2: School sampling information

Table 16: List of 29 schools that have been the focus for this evaluation

Status	School	Cohort	CPD Units	Infant / Primary	Middle / secondary	Pupils	Delivery Partnership	Rating pre-AtS	Rating since AtS where more recent inspection report has been completed	Days after AtS engagement date that most recent inspection report was completed
Complete Journey	All Saints Catholic High School	1	5.4		✓	900	Knowsley	3	→ 3 (same)	175
Scunthorpe EL Case Study	Althorpe and Keadby Primary School	2	36.8	✓		223	Scunthorpe	2	no report since engagement	n/a
Self-supplied case study	William Howard School	2	17.48		✓	1428	Cumbria	3	2 (improvement)	292
Complete Journey	Danesfield Church of England Middle School	2	3.8		✓	322	West Somerset	3	→3 (same)	190
Complete Journey	Downs Barn School	2	1.8	✓		121	Milton Keynes	2	no report since engagement	n/a
Complete Journey	Ellesmere Park High School	2	13.1		✓	715	Salford	2	new school (academy) so no report yet or to compare with pre-AtS report	n/a
Self-supplied case study	Halewood Academy	1	13.53		✓	971	Knowsley	2	no report since engagement	n/a
Complete Journey	Haydock High School	2	9.6		✓	707	St Helen's	3	4 (decline)	328
Partial Journey	Hearsall Community Academy	1	0		✓	404	Coventry	New school	2	713
Self-supplied case study	Irlam and Cadishead College	2	5		✓	604	Salford	4	no report since engagement	n/a
Self-supplied case study	Kirkby High School	1	7.1		✓	874	Knowsley	4	↑ 3 (improvement)	393
Self-supplied case study	Lord Derby Academy	1	9.43		✓	1007	Knowsley	3	→3 (same)	500
Complete Journey	Oakfield Primary School.	1	0.9	✓		318	Scunthorpe	3	→ 3 (same)	149

Status	School	Cohort	CPD Units	Infant / Primary	Middle / secondary	Pupils	Delivery Partnership	Rating pre-AtS	Rating since AtS where more recent inspection report has been completed	Days after AtS engagement date that most recent inspection report was completed
Partial Journey	Parklea Primary School, previously Sundon Park School)	1	26.2	✓		218	Luton	3	↑ 2 (improvement)	21
Self-supplied case study	Prescot High School	1	0		✓	801	Knowsley	3	↓ 4 (decline)	491
Self-supplied case study	St Thomas More Catholic Academy	1	13.59		✓	1200	Stoke-on-Trent	2	no report since engagement	n/a
Complete Journey	The Sutton Academy	2	20.63		✓	1200	St Helen's	3	→ 3 (same)	299
Self-supplied case study	The Unity School	1	9.8		✓	951	Blackpool	3	no report since engagement	n/a
Self-supplied case study	Willen Primary School	2	3.3	✓		363	Milton Keynes	2	no report since engagement	n/a
Scunthorpe EL Case Study	Willoughby Road Primary Academy	2	1.8	✓		376	Scunthorpe	3	↑ 2 (improvement)	356
Scunthorpe EL Case Study	Winterton C of E Infant's School	2	7	✓		217	Scunthorpe	3	↑ 2 (improvement)	365
Self-supplied case study	The Discovery Academy	1	10.44		✓	1145	Stoke-on-Trent	3	→ 3 (same)	357
Self-supplied case study	Bilston C of E Primary School	2	6.3	✓		420	Wolverhampton	2	→ 2 (same)	346
Ofsted Case Analysis	Ofsted 1: Baines School	1	32.79		✓	845	Blackpool	3	→ 3 (same)	712
Ofsted Case Analysis	Ofsted 2: Merrill Academy	1	16.8		✓	747	Derby	4	→ 4 (same)	435
Ofsted Case Analysis	Ofsted 3: Saint Benedict	1	10.7		✓	1341	Derby	4	↑ 2 (improvement)	419
Ofsted Case Analysis	Ofsted 4: John Whitgift Academy	2	16.3		✓	628	South Humber	3	↑ 2 (improvement)	492
Ofsted Case Analysis	Ofsted 5: Oakwood Academy	2	1		✓	686	Nottingham	3	→ 3 (same)	393
Ofsted Case Analysis	Ofsted 6: Fleetwood High School	1	1.8		✓	877	Blackpool	3	→ 3 (same)	364

Appendix 3: Detailed methodology for Ofsted report review

In total, 206 schools were recruited, and 191 were still 'active' in the Programme as at the end of February 2020. As the figure below illustrates, 82 of these 191 schools have had an Ofsted report both prior to, and since, engaging with the Programme. Feasibly therefore, any observations about change in STEM at schools by inspectors might feature in their most recent reports.

Key				
1	Outstanding			
2	Good			
3	Requires improvement			
4	Inadequate			
		Total schools with an observed change between pre-ATS and since ATS engagement		
↑	4 to 3	**9**		**39 had a higher rating between inspections**
↑	4 to 2	**2**		**48%**
↑	3 to 2	**27**		
↑	3 to 1	**1**		
↑	2 to 1			
↔	4	**1**		**38 had the same rating between inspections**
↔	3	**24**		**46%**
↔	2	**13**		
↔	1	**0**		
↓	3 to 4	**3**		**5 had a lower rating between inspections**
↓	2 to 4	**1**		**6%**
↓	2 to 3	**1**		
	Total	**82**	**43%**	Total schools who it is possible to compare pre and since AtS engagement
	Total	**109**	**57%**	New schools or schools that have not had an inspection since pre AtS engagement
	Total	**191**	**100%**	

Given that the intended outcomes of the Aspire to STEM engagement activities will take time to come through, it was decided to focus on schools that had received a full inspection report at least 1 year after their engagement with the Programme. This reduced the sample from 82 to 39 schools.

The original method was agreed to review the most recent reports for these 39 schools, and using an agreed keyword search process identify any references to STEM and / or the language used to describe the Programme's aims ambitions. This would simply be to establish if there were any patterns, for example, amongst those whose ratings had remained the same, improved or gone down since their previous inspection.

Following a trial of the method, search terms were finally agreed to include Science, Technology, Engineering, Mathematics, Design, Computer (*Science*), leadership, (*professional*) development, training, disadvantage, pupil outcomes, community, parent, career and enrichment. Words that did not return any discoveries included STEM, pedagogy and Science capital. Aspire to STEM has not been mentioned specifically in any of the Ofsted reports reviewed.

Very few Programmes or branded initiatives are name-checked by inspectors in school reports; only a two were observed in this review process and neither were STEM-related – they were however about enabling opportunities for disadvantaged students and raising aspirations more generally within the school.

Having completed the process of reviewing the 39 schools' most recent Ofsted inspection reports, there were some references to STEM subjects, leadership, teaching, learning and assessment and pupil outcomes. More references were made to Mathematics, Science and 'Technology' than Computer Science and Engineering.

However, it became clear that to understand progress within a school it would also be necessary to review the previous inspection reports in order to better understand why any changes had come about at a school. The methodology therefore evolved, and it was agreed to identify 6 cases to review in more depth using pre-AtS and since AtS reports. This would help identify other contributors to any STEM changes observed by inspectors.

Where a STEM subject has been included in the 'deep dive' element of an Ofsted inspection more revealing comments are discovered that help to better understand wider contributors to changes in subject leadership, pupil outcomes in STEM subjects and / or professional development within the subjects. These are often wider whole school improvements to which Aspire to STEM conceivably may have contributed.

More reliable attribution of outcomes to the Programme are illuminated through the triangulation of document review, engagement data, CPD/activity feedback and interviews with a school key contact and their designated STEM Learning Centre Educational Lead i.e. the partial and complete journeys referenced in this report and contained in full in a separate companion document supplied to STEM Learning Centre by Skyblue in April 2020.

Appendix 4: Aspire to STEM Monitoring Data

This table is a summary of CPD and event delivery as at end March 2020

1 Participant Breakdown		**Cohort 1**		**Cohort 2**		**Notes**
Educational Phase		Primary	Secondary	Primary	Secondary	
Number of SLT		75	129	195	242	
Number of teachers *(inc SLT)*		**320**	**687**	**672**	**1123**	
Total number of teacher engagement with subject specialism in:	Science	77	232	139	421	Figures provided during the schools needs analysis.
	Technology	27	84	51	103	
	Engineering	7	23	6	51	
	Maths	69	151	130	245	
	Computing	27	62	57	95	
	Other	113	135	289	208	
2 CPD Events						
Total number of CPD events to date, per subject area:	Science	99	293	211	474	
	Technology	37	73	44	55	
	Engineering	10	32	22	37	
	Maths	75	104	102	154	
	Computing	62	95	67	135	
	Leadership	68	129	97	152	
	Other	26	68	54	77	NQT, RQT, Technician
3 Community Events						
Total number of community events		39		40		

Technical Notes

[1] https://www.gov.uk/guidance/teaching-and-leadership-innovation-fund.
[2] Schools in the same partnership all belonged to the same cohort.
[3] https://www.stem.org.uk/career-benchmarks.
[4] The AtS Programme manager explained that 201 schools were still engaged in the Programme at closure but 10 of these were less active than a core of 191 defined as 'active.
[5] Some bespoke sessions delivered at the school locality may not have been set up on the booking system but organised locally. As is the same for the third-party delivered CPD, as well as coaching/mentoring/consultancy delivered by the Educational Lead.
[6] N=2519 activities recorded between 2018 and 2020.
[7] 61 (32%) schools were rated 'good', 1 was rated 'outstanding) and 22 (12%) were new schools with no inspection report to draw on for their rating prior to AtS Programme engagement.
[8] The selection of these 10 schools were in the words of the Educational Lead *"not necessarily the best case studies or the most successful engagement, but of those we have received, provide a balance of different activities, support accessed and impacts."*
[9] This is called the impact reference table and is found in all School Action Plans.
[10] The extent of attribution was not defined during the interview, a limitation due to the timing constraints with the telephone approach adopted.
[11] One of these interviewees was also the lead contact in a school, so spoke from both perspectives.
[12] Fidelity/adherence – the extent to which implementers adhere to the intended treatment model; Dosage – how much of the intended intervention has been delivered and/or received.
[13] https://www.gov.uk/government/news/social-mobility-package-unveiled-by-education-secretary.
[14] 3 schools had gone from a rating of 3 to 4, whilst 1 school had gone down from a 2 to a 3 and one had gone from a 2 to a 4. A review of their latest inspection reports found that the reasons for their reduction in rating included: instability caused in the period as a result of several different head teachers and many changes in teaching staff; a lack of leadership quality and an inability to raise standards school-wide; lack of subject leader experience and skills; the proportion of lessons covered by temporary staff further contributing to negative pupil learning behaviours; lack of quality in governance and use of funding; Leaders have introduced a curriculum that does not meet the needs of pupils well enough; a curriculum that is too narrow that fails to meet pupils needs well enough; senior leaders, including governors and trustees, allowing the quality of education to fall to an unacceptable standard.
[15] However, 'deep dives' by inspectors that focussed on the strongest and weakest performing subject areas only meant that a stable Science department might not receive any attention (or credit) in reports.
[16] The volume of subject leaders appears to be low but some subject leaders may have self-classified as 'teacher' instead.
[1] Based on % of respondents strongly agreeing with the statement.
[17] Early Years Foundation Stage.
[18] Data provided by STEM Learning March 2020.
[19] Quality of teaching, pupil learning, quality of subject leading and STEM careers education.
[20] https://transformingpractice.sciencemuseum.org.uk/what-is-science-capital/.
[21] Source: https://transformingpractice.sciencemuseum.org.uk/eight-dimensions/. Aspects of science capital not observed were: Science related attitudes and values and Consumption of science-related media.
[22] https://competition.thebigbangfair.co.uk/finalists-2020/.
[23] Another example is a subsequent increase in the number of attending parents' evenings.
[24] Source STEM Learning Centre D3 form analysis. N=1,439
[25] Noting that the overall extent of ambition and challenge is set by subject leaders or by the school's leadership team.
[26] Further analysis of this finding would enable us to identify if particular types of staff were expressing satisfaction or dissatisfaction, as well as revealing more about the types of staff who have not yet used the resources.
[27] Source: https://transformingpractice.sciencemuseum.org.uk/eight-dimensions/. Aspects of science capital not observed were: Science related attitudes and values and Consumption of science-related media.
[28] In order to reach a conservative assessment, each outcome has been coded once, rather than multiple times(i.e. an example being used to represent / interpreted more than one type of outcome).
[29] Drawing on primary and secondary evidence supplied by the school, the Partnership area and the Educational Lead. This group of schools consisted of 4 secondary and 3 primaries (2 from cohort 1 with the remainder from cohort 2). Together, these schools had gained 55.2 CPD units (276 CPD hours).
[30] The extent of attribution was not defined during the interview, a limitation due to the timing constraints with the telephone approach adopted.
[31] Based on an assessment of the journeys of 4 or more of the 7 schools. Particularly variation, both in start and end points was seen in the quality of subject leadership.
[32] The median is 0.7% of total budget, and an overall spend of £255 million. https://tdtrust.org/post-code-lottery-teachers and https://tdtrust.org/2018-spend-pressrelease.
[33] N=2519 activities recorded between 2018 and 2020.
[34] https://www.sthelensreporter.co.uk/education/claims-schools-resisting-support-st-helens-council-104054.

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