Evaluation of STEM Learning's ENTHUSE Partnerships Programme

2020–2023

Final report

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CFE research

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For more information, please contact:

CFE Research
Phoenix Yard, Upper Brown Street,
Leicester, LE1 5TE

0116 229 3300
hello@cfe.org.uk
www.cfe.org.uk

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Executive Summary

ENTHUSE Partnerships funded and managed by STEM Learning aim to increase student attainment and engagement in STEM subjects and develop pupils' awareness and understanding of STEM careers. Collaborative partnerships involving a group of 6–10 schools or colleges receive up to £25,000 of funding that they can use towards a variety of continuing professional development (CPD) and enrichment activities. Since 2014, ENTHUSE Partnerships has supported over 360 partnerships reaching several thousand primary and secondary schools in the UK.

This independent report by CFE Research presents the findings of a process and impact evaluation of ENTHUSE Partnerships covering the period 2020–2023. The evaluation builds on findings from a previous study in 2017 and explores school leaders', teachers' and wider stakeholders' experiences of the programme and the outcomes and impacts achieved for schools, teachers and pupils.

Evaluation approach

The evaluation draws on a documentation review and secondary survey data collected by STEM Learning from school leaders, teachers and pupils at three different time-points – the start, middle and end of the ENTHUSE Partnership. Four paired in-depth scoping interviews with various senior stakeholders, including representatives at STEM Learning, together with 16 in-depth interviews with teachers, science leaders and ENTHUSE Advisers were also conducted.

Key findings

Evidence from the evaluation suggests that participating in an ENTHUSE Partnership can result in a variety of educational impacts. Schools which commit to engaging fully in a programme of STEM CPD and enrichment activities, such as STEM clubs, are more likely to continue to commit to and embed these activities into their curriculum for future cohorts of pupils. This can lead to success and sustainability beyond the initial ENTHUSE Partnership funding period. Advisers and senior school leaders identify the longer-term impacts of this approach as increased STEM subject take-up post-16, an increase in attainment in STEM subjects and a greater awareness of STEM careers.

Teacher impacts

Teachers report significant impacts from participation in an ENTHUSE Partnership including:

– Increased access to high-quality CPD and teaching resources that positively impact their subject knowledge, teaching practice and pedagogy:

95%
agree that they are confident in their subject knowledge

79%
agree that they have access to teaching resources

72%
agree that they have access to high-quality development opportunities

In addition:

– **92%** of teachers agree that they understand the rationale of how the curriculum in their STEM subject is structured for lesson planning and assessment.
– **92%** agree that they are confident in delivering practical activities.
– **65%** agree that they can confidently lead STEM enrichment activities.

Teachers have particularly enhanced their understanding of STEM careers and pathways:

89%
of secondary teachers agree that they have knowledge of employability skills

77%
of secondary teachers agree that they have good up-to-date knowledge about STEM-related further study options

75%
of primary and secondary teachers agree that they can confidently make links to a range of STEM jobs in their teaching

61%
of primary and secondary teachers agree that they have good up to-date knowledge of STEM jobs

> I think ENTHUSE has had more impact than I expected. I thought that I would go to these meetings and get some free CPD, but I didn't really expect [teacher and pupil] engagement in science to increase so much as it has.
>
> **Senior leader**

Pupil impacts

Several pupil impacts have been achieved from the partnerships, particularly for primary school pupils:

Increased opportunities to participate in enrichment activities.

– **67%** of primary school pupils agree that they got the chance to take part in STEM activities such as clubs and competitions.

> I think the pupils that have taken part in enrichment always start with an interest in science, but they have grown to love science and STEM, and that will help them improve across the board.
>
> **Teacher**

Increased enthusiasm and enjoyment in STEM subjects.

– **86%** of primary school pupils agree that they would like to learn more about STEM subjects.

Improved ability to make links between science and the everyday world.

– **83%** of primary school pupils agree that they read stories and hear about real-life problems to help them learn in STEM subjects.

An increased belief that they can do well in STEM subjects.

– **88%** of primary school pupils agree they can do well in STEM subjects.

Improved knowledge about STEM careers and further study pathways.

– **84%** of primary school pupils agree that they learn about the jobs that people do.

School and partnership impacts

Positive school and partnership outcomes, resulting from participation in an ENTHUSE Partnership include:

– **An increased profile of STEM subjects in schools**

– **Increased collaboration and knowledge transfer between partner schools**

– **Stronger links with regional networks**

– **Sustainability beyond the funding period**

> ENTHUSE has been good in terms of strengthening connections between schools and establishing that network. I think that's been, for me, the most helpful.
>
> **Early career teacher**

Stakeholders identify key factors that contribute to a successful and sustainable partnership:

- **Partnership funding** can be used flexibly for CPD, enrichment activities and staff release time.
- **A clear vision** for the partnership with guidance from an experienced Adviser who has links to STEM Learning and local employers.
- **Establishing strong senior leadership** to foster and sustain school and employer collaborations.
- **Matching school and employer priorities** to ensure all parties can benefit.
- **Tailored CPD** via STEM Learning and local provision to ensure different training needs can be fully met.
- **Bespoke enrichment activities** for pupils to inspire and engage them in STEM subjects.
- **Employer co-funding and in-kind contributions** to help develop STEM clubs and competitions, industry placements for teachers and work experience for pupils.
- **Streamlined monitoring, evaluation and reporting processes** to reduce the administrative burden on staff.

Considerations

To inform the future of the ENTHUSE Partnerships, STEM Learning may wish to consider the following areas:

- **Support partnerships to thrive throughout and beyond the funding period** by considering the most effective ways for partnerships to remain *fully active*. The Adviser role is critical to the success of partnerships, especially those at risk of withdrawing or becoming inactive, and can help them to become sustainable.
- **Encourage partnerships to establish stronger links with both primary and secondary schools.** It is essential that the outcomes achieved for primary pupils are not lost when they transition to secondary school. There is an opportunity for partnerships to focus more fully on the transition stage between primary and secondary school by ensuring one or more secondary schools are involved in the partnership. Developing a fuller understanding of why secondary school pupils' perceptions of STEM subjects and careers become less positive over time is important to help partnerships develop activities to address declines.
- **Implement more robust and streamlined approaches to monitoring and evaluation** to enable the outcomes and impacts of the programme to be more accurately captured and attributed to the partnerships and to reduce the burden on teachers and pupils. Consider developing a suite of creative pupil data collection methods that can be implemented for in situ activities to collect immediate feedback (e.g. through an app or photo capture method, pupil focus groups, short interviews).
- **Review marketing and branding methods** and use evaluation findings and case studies to raise awareness of the ENTHUSE brand and the impacts achieved for schools and employers. Developing tailored materials for employers that showcase the specific outcomes for them and the range of ways in which they could support schools could help to increase employer engagement in the programme.

Introduction

This report presents the findings of an independent process and impact evaluation of ENTHUSE Partnerships conducted between December 2023 and August 2024. It explores the impact of participation in the programme for teachers, pupils, schools and partnerships and identifies the underlying factors that characterise successful partnerships as well as highlighting the challenges experienced by schools involved in partnerships. The determinants of partnership sustainability are also explored.

About the ENTHUSE Partnership programme

ENTHUSE Partnerships form an ambitious programme that seeks to increase student attainment and engagement with STEM subjects and develop pupils' awareness and understanding of STEM careers, contributing to the Gatsby Careers benchmarks.[1] Since its launch in 2014, ENTHUSE Partnerships have supported over 360 partnerships over 27 cohorts. The partnerships involve a collaboration between a group of 8–10 schools or colleges, supported by STEM Learning and sometimes an external funder.[2] The partnerships in this evaluation have usually received up to £25,000[3] to contribute to a variety of activities, including:

- CPD for teachers and science technicians delivered at STEM Learning's National STEM Learning Centre in York and by local delivery partners across the UK.
- Access to teaching resources.
- Teacher placements in industry and higher education.
- Support to develop the STEM curriculum and subject leadership.
- Training to establish new STEM clubs and support for existing ones.
- Guidance from a dedicated Adviser appointed by STEM Learning.
- Access to the STEM Ambassadors initiative, linking schools with 28,000 Ambassadors who offer their time and experience to enrichment activities. (STEM Ambassadors are volunteers from a wide range of STEM-related jobs across the UK).

The partnerships included in this evaluation were at various stages in their lifecycle, ranging from new partnerships starting within the last 12 months to those that have now been completed. There is also a range of delivery models, with remote and hybrid working common both during and after the pandemic. Partnerships have the autonomy to address the teaching and learning challenges for their setting and to focus on specific pupil groups. Each partnership is led by one school and supported by a STEM Learning Adviser. The Adviser's role is to help shape each partnership's

[1] https://www.gatsby.org.uk/education

[2] External funders are usually a charitable trust, STEM employer, professional institution or scientific society that is committed to investing in developing the skills required for the STEM workforce.

[3] Funding was increased from £20,000 to £25,000 in 2022 up until September 2023 (cohort 23).

aims, identify activities, provide challenges, assess success, and identify ways for the partnership to achieve sustainability beyond the funding period. Each partnership develops an action plan, and the costs associated with these activities. The partnerships are asked to focus on up to two STEM subjects from science, technology, engineering and mathematics, with most partnerships prioritising one subject, with science being the most common choice.

STEM Learning collects a range of management, monitoring and evaluation data to assess the effectiveness and impact of the partnerships. In the period being evaluated, partnerships were encouraged to complete baseline school, teacher and pupil surveys at the start of the partnership and follow-up surveys for teachers and pupils at the middle and end of the partnership period.

A previous independent evaluation of ENTHUSE Partnerships in 2017[4] reports that partnerships positively impact pupils' interest towards and attainment in STEM subjects and awareness of STEM careers. Teacher and school-level impacts are also reported, including improved knowledge about STEM subjects and associated careers and increased confidence to teach STEM subjects. Evidence that partnerships are sustainable models beyond the funding period is also reported.

STEM Learning identifies the ENTHUSE Partnerships success criteria for schools and employers as follows:

Schools:

– Improved outcomes for young people.
– Increased collaborative working during the partnership, leading to a sustainable network that can share good practice and resources.
– Partnership schools can take advantage of the full STEM Learning offer available to them through use of the school support funding.
– Investment in teacher CPD leads to improved retention.

Employers:

– Developing a national, regional and local talent pipeline.
– Corporate social responsibility aims are achieved through participation or support of ENTHUSE Partnerships.
– Employers mobilise their own STEM Ambassadors.
– Employers can work with a trusted partner with a nationally recognised, structured programme that offers value for money.

From September 2023, new partnerships will be supported for one year with funding secured from employers, corporate organisations, Trusts or Foundations to address a specific issue.

[4] https://www.stem.org.uk/system/files/elibrary-resources/2017/08/ENTHUSE-partnerships-programme-final-report_0.pdf

Evaluation approach

Documentation and data for the evaluation has been collected in three phases, as set out below:

Inception and scoping

This stage comprises a review of existing evaluation evidence, management information (MI) and programme documentation. STEM Learning shared documentation for 16 ENTHUSE Partnerships which they considered to be exemplary in achieving positive impacts. CFE reviewed the documents to identify processes underpinning successful partnerships and to inform the sampling criteria and design of research instruments for three case studies. Four paired scoping interviews with STEM Learning representatives, ENTHUSE Advisers and local delivery partner teams were also conducted.

Secondary survey analysis

Analysis of STEM Learning's internally designed and administered online, and paper surveys completed by school leaders, teachers and pupils forms a central part of the evaluation. Survey data for cohorts 8–23 (between January 2020 and June 2022) is included in this review.

School surveys (lower primary, upper primary and secondary) achieve high baseline response rates that are representative of the wider population of partnerships. However, response rates significantly decrease at the mid-point survey and even further at the end of partnership survey. This could be due to a variety of reasons from simple survey fatigue, a less concentrated effort to secure completed survey returns, drop-off in ENTHUSE activities or withdrawal from the partnership. In addition, data from partnerships starting in Autumn 2022 is also included in this analysis and therefore these respondents will have only completed their start survey and will have not yet reached their mid-point. Considering these aspects means a degree of caution should be applied when interpreting the end of partnership survey data due to small sample sizes and the low percentage of partnerships represented. The exact timing of the distribution of pupil surveys in relation to partnership interventions delivered and which pupils received the survey (i.e. whole year groups or just those receiving the intervention) is unknown. Plus, pupils may have received STEM interventions as part of other initiatives, so it is not possible to definitively attribute changes in pupils' perceptions to ENTHUSE Partnerships.

Teacher survey

STEM teachers from lead and partner schools received an online survey at three sampling points: the start, middle and end of the partnerships. This approach aims to measure change in perceptions over time about pupils' interest and engagement with STEM subjects, teaching practice and pedagogy, confidence to teach STEM subjects, knowledge of STEM study options and career pathways, employer engagement and opportunities for pupils to participate in STEM enrichment activities. Almost eight in ten (78%) partnerships are represented in the baseline survey. One-third (33%) of partnerships are represented in the follow-up data returned at the

middle point of the partnership and only one in ten (11%) are represented at the end of the partnership. The sample sizes were large enough to warrant analysis by sub-group; that is, school phase and length of time in the teaching profession. The response rate achieved across the three surveys is shown in Table 1.

Table 1: Teacher survey response rates from 197 represented ENTHUSE Partnerships.

	Baseline (%)	Middle of partnership (%)	End of partnership (%)
Number of survey responses	2,393 (100%)	650 (27%)	161 (7%)
Number of the 197 partnerships represented	154 (78%)	65 (33%)	22 (11%)

Pupil surveys

Pupils from participating schools received surveys at three sampling points: the start (baseline), middle and end of the partnership. Three different versions of the survey were administered, with the wording and focus adapted for different age groups: lower primary (Reception to Year 2); upper primary (Years 3–6); and secondary (Years 7–11). These surveys explore pupils' interest and engagement with STEM subjects, enrichment activities and STEM careers, recall of different practices adopted in STEM lessons and participation in employer-led activities.

Most returned data was from paper versions of the survey, where teachers had collated the raw data and submitted aggregated scores or percentages. In 2022, an online survey was introduced. CFE has merged the online survey data with the aggregated paper survey scores (but is has not been possible to merge the percentage scores). Due to most of the data being at the aggregate level, analysis has been computed at the whole sample level for each of the three different surveys. Sub-group analysis by year group and gender has not been possible. The proportion of partnerships represented across the three pupil surveys is hard to ascertain, as only the school's name (and not the lead partner) was recorded in the data received. There are large baseline samples for these three surveys (c. 4,000–6,000 in each survey); however, as previously highlighted, there is significant attrition between the baseline survey responses and mid- and end-point survey responses. The lower primary group shows an 88% drop in responses at the middle of the partnership, the upper primary drops by 67% and the secondary by 76%. The survey response rates achieved are presented in Table 2.

Table 2: Pupil survey response rates by school phase.

Survey	Baseline	Middle (%)	End (%)
Lower primary	4,748	545 (12%)	81 (2%)
Upper primary	6,170	2,025 (33%)	360 (6%)
Secondary	4,089	973 (24%)	74 (2%)

School baseline survey

School leaders and teachers with overall responsibility for leading the ENTHUSE partnership in each of the participating schools were invited to complete an online survey at the start of the partnership. The survey captured baseline information about the quality of STEM teaching and learning, readiness to collaborate, employer engagement and provision of STEM enrichment activities.

A total of 790 responses were achieved from 160 of the 197 partnerships (81%), a highly representative baseline sample. Primary schools were responsible for 57% of those responses, secondary schools 39%, with middle schools and further education colleges returning 2% each. Three-quarters (73%) of responses were from partner schools, 15% from lead schools, while 12% did not record their partner status. Science was the only focus for most partnerships (73%), with computing (11%), design and technology (8%), engineering (4%), maths, (2%) and other specialist subjects, for example, physics, biology, chemistry, (2%).

Primary case studies

Three partnerships (Greenbank, Pokesdown and President Kennedy) were selected from the documentation review of the 16 high-performing partnerships,[5] to develop into case studies to showcase the factors underpinning successful partnerships (Appendix 1) A total of 16 depth interviews with various stakeholders across the three partnerships were conducted with:

– STEM Learning Advisers.
– School leaders, that is, Headteacher, Executive Headteacher, Deputy Headteacher, Assistant Headteacher.
– STEM subject leaders, for example, Science Subject Leader, Head of Science, Head of Design and Technology.
– Science teachers including early career teachers.
– Science technicians.
– Local delivery partners.

[5] Case studies were defined as 'high performing' if they were actively engaged in enrichment activities, had instigated a range of enrichment activities following the CPD, had actively made and sustained links with employers and had a strong sustainability plan.

– Industry and employer representatives who supported partnerships.

Several topics were explored during the interviews, such as the focus of the partnership; planning and design stages; the range of activities delivered; collaboration; observed outcomes and impacts for children, teachers, schools and the partnership; and sustainability plans beyond the funding period.

Teacher impacts

Participating in ENTHUSE Partnerships generates a range of benefits for teachers, including:

– Increased access to high-quality CPD.

– Improved teaching practice and pedagogy, including knowledge of STEM.

– Increased confidence in delivering practical lessons, enrichment activities and activities involving employers and the wider community.

– Increased access to resources to enhance subject leadership, lesson planning and assessment skills.

– A heightened understanding of STEM careers and study pathways.

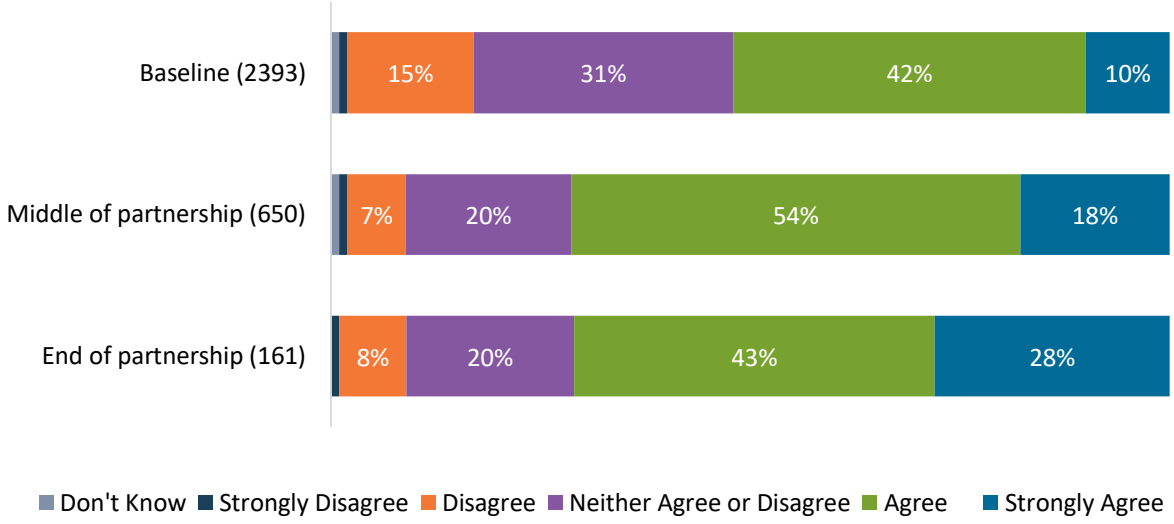
Teaching practice and pedagogy

At the outset of the partnership, many schools/teachers did not have access to STEM CPD. This was for a variety of reasons, such as budgetary constraints, lack of time to devote to CPD and limited access to locally available high-quality CPD. Both Primary and Secondary schools describe not always having the budget for residential training for teachers or to fund travel and release time with appropriate cover for teachers attending CPD. Primary schools are more able to provide cover for teachers than secondary schools, which find it more difficult to provide subject specialist cover.

ENTHUSE Partnerships provide teachers and staff, irrespective of school phase, with access to high-quality professional development opportunities related to their STEM discipline, which in turn has a positive impact on their teaching practice and subject and pedagogical knowledge (Figure 1).

At the start of the partnership, **52%** of teachers strongly agree or agree that they had access to high-quality development opportunities related to their STEM subject.	**At the end of the partnership, 71% strongly agree or agree with the statement, representing a 19% increase.**

Figure 1: Extent of agreement with the teacher survey statement 'I have access to high-quality professional development opportunities related to [my STEM subject]'.[6]



Most interviewees across all school phases convey that access to high-quality professional development opportunities is a key strength of ENTHUSE Partnerships. Teachers perceive that practical, action-orientated CPD is the most useful and effective to them in their teaching practice. For example, they report how the interactive CPD provided by the STEM Learning Centre in York gives contextual examples of how to deliver an effective STEM lesson, which is particularly beneficial. These provide teachers with a simple, yet effective approach to investigations that can be easily incorporated into existing lessons, negating the need for pupils to listen to teachers and write for the duration of the lesson. Teachers describe how this approach to CPD helps spark enthusiasm for innovative ideas and reignites their interest in STEM, particularly when they can also discuss and share ideas with other teachers.

> I think the training sessions that we have attended have been very interactive. We don't always get an opportunity to sit down as a staff and discuss certain topics.
>
> **Teacher**

Primary school teachers describe how they particularly value the CPD that helps them to teach pupils to think scientifically and how this can be assessed in class. In the partnership action plans reviewed, secondary school science leaders highlight the importance of learning more about the primary STEM curriculum to assist in greater seamless transitions from primary to secondary. Secondary school teachers also describe how CPD which supports them to set up and run STEM clubs is

[6] Percentages of <5% are not included in the charts.

particularly beneficial in inspiring them to be innovative in their approach to enrichment.

After receiving training from local delivery partners, science leaders who became CPD facilitators perceive that providing teachers with practical examples that they can take back to their classroom supports them in understanding the value of stepping back and allowing children to lead classroom discussions. This benefits pupils by encouraging them to be more inquisitive in STEM lessons by asking more questions, promoting listening skills and developing discussion skills:

> [Teachers] are encouraged to look around and see the variations, so that when they teach the children, they're less prescriptive and they're more able to allow children to develop their understanding by following their own questions, some of the time.
>
> **Adviser**

Both primary and secondary school teachers consistently state that the sharing of information, knowledge and expertise is one of the most valuable outcomes of ENTHUSE Partnerships. Early career teachers (ECTs) value the new knowledge and insights and more experienced teachers enjoy networking in regular partnership meetings, refreshing their knowledge and reigniting interest and motivation in STEM subjects:

> Just working with other colleagues [from other schools]. We mustn't underestimate the impact that has [on teachers]. One of the byproducts [of training] is just being able to be with other colleagues of similar positions in different schools and hearing what they're doing.
>
> **Senior leader**

> When we have our termly meetings, people swap ideas. They go to each other's schools. I've been invited to a couple of the science fairs that have been held and been a judge at a competition. There's a lot of sharing.
>
> **Teacher**

Science technicians have also benefitted from the CPD delivered by STEM Learning. They identify that these CPD opportunities are only possible because of the ENTHUSE partnership funding. They describe how opportunities to network with other technicians from different schools gives them insights into how they can further enhance the support they provide in science lessons making them more engaging by offering more practical investigations and activities not offered in previous lessons:

> I've done all three technician courses now at STEM Learning in York for biology, chemistry and physics. You're given time to see the practical's and [see] how you can fit that into what you do in your school. I wouldn't have had that experience if we hadn't been in the partnership.
>
> **Science technician**

ENTHUSE Advisers convey how being part of a partnership has led to an increased drive for science leaders and teachers to undertake more training to improve their subject knowledge, teaching practices and pedagogy resulting from the positive impacts they have observed on pupils (discussed in the next chapter).

Increased confidence

To effectively teach engaging STEM subjects and lead enrichment activities, teachers need to have confidence that they possess the necessary subject-specific skills and knowledge. A strong finding to emerge is that teachers report increased confidence in their STEM subject knowledge and ability to deliver practical, enquiry-based STEM lessons and to lead enrichment activities because of the high-quality CPD they have engaged in as part of the partnership.

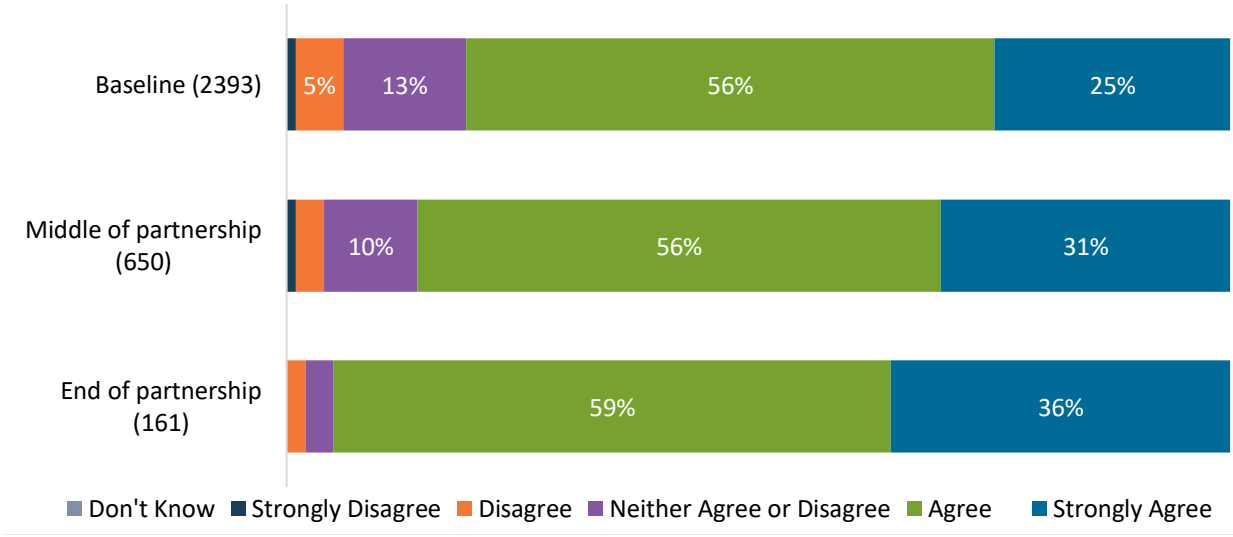
Most teachers report being relatively confident in their subject knowledge at the outset of the partnership, but this varies by school phase and experience. Confidence in subject knowledge increases over the course of the partnership (Figure 2):

– Overall, at the start of the partnership, around four in five (81%) teachers strongly agree or agree that they are confident in teaching the subject knowledge for their subject.

– Baseline confidence levels vary by school phase and length of time in the profession. Only one in 10 (12%) primary teachers strongly agree that they are confident compared with almost half (47%) of secondary teachers. Only 15% of ECTs compared with 27% of teachers with over 5 years' experience strongly agree that they are confident in their subject knowledge.

– At the end of the partnership nearly all teachers (95%) strongly agree or agree that they are confident in their subject knowledge, representing a 14% increase.

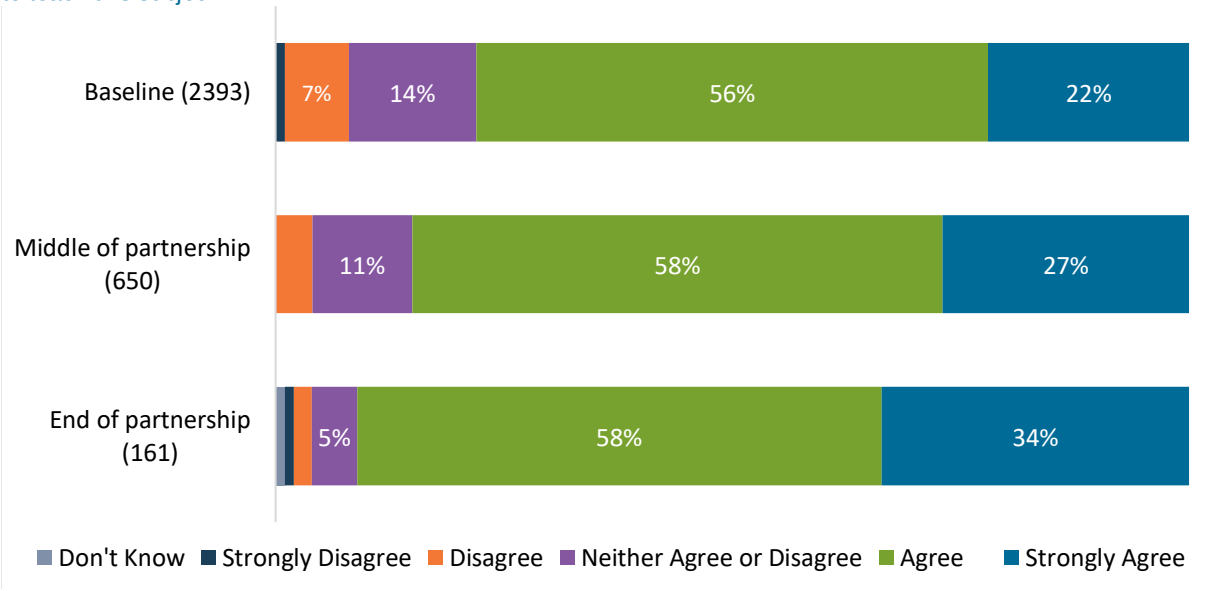
Figure 2: Extent of agreement with the teacher survey for the statement 'I am confident in teaching the subject knowledge for this subject'.



Teachers also report increased confidence in employing practical activities to teach STEM subjects after engaging in CPD opportunities via the partnership (Figure 3):

– At the start of the partnership, around four in five teachers (78%) strongly agree or agree that they were confident in delivering practical activities.
– Primary teachers (73%) report lower confidence than secondary teachers (87%) at the start of the partnership.
– At the end of the partnership, 92% of teachers strongly agree or agree with this statement, representing a 14 percentage-point increase since baseline.
– Differences in confidence levels between primary and secondary school teachers disappear at the end of the partnership.[7]

Figure 3: Extent of agreement with the teacher survey for the statement 'I am confident at using practical activities to teach this subject'.



A further positive impact of the ENTHUSE Partnerships is that teachers report increased confidence to lead STEM enrichment opportunities (Figure 4):

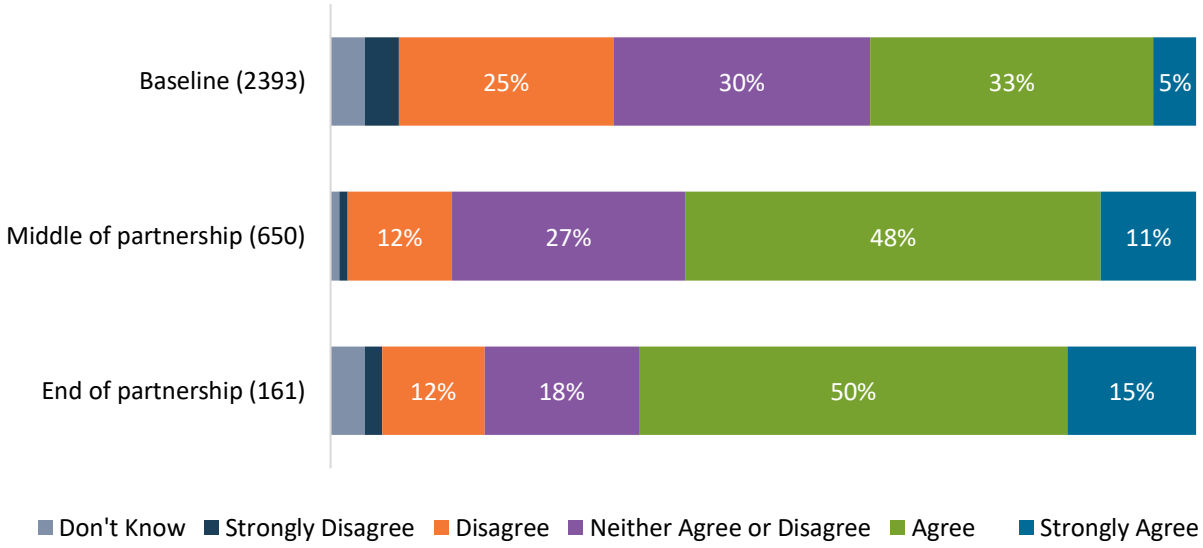
– At the start of the partnership, only around two in five teachers (38%) strongly agree or agree that they could confidently lead STEM enrichment activities.
– Primary teachers report particularly low confidence in delivering enrichment activities compared with secondary school teachers at the outset of the partnership.[8]
– At the end of the partnership, nearly two-thirds (65%) of all teachers strongly agree or agree that they could confidently lead STEM enrichment activities, representing a 27 percentage-point increase.
– Confidence to lead STEM enrichment activities increases by 31 percentage points for both primary and secondary teachers at the end of the partnership.[9]

[7] 91% of primary teachers strongly agreed or agreed they are confident compared with 94% of secondary teachers.

[8] 28% of primary teachers strongly agreed or agreed they are confident compared with 58% of secondary teachers.

[9] 59% of primary teachers strongly agreed or agreed and 89% of secondary teachers strongly agreed or agreed.

Figure 4: Extent of agreement with the teacher survey for the statement 'I can confidently lead STEM enrichment opportunities.



Teacher and science leader interviewees also highlight that since attending CPD sessions hosted by STEM Learning, they feel more confident to teach their subject and lead enrichment activities. This is because they have further developed their specialist knowledge and the CPD has provided them with new ideas to deliver engaging lessons:

> I went on the physics specialist course, it was revolutionary. I think that the CPD for me personally has completely changed me as a teacher… It gave me confidence, knowledge and ideas.
>
> **Science leader**

CPD delivered via the ENTHUSE Partnership has also provided teachers with the confidence to streamline their approach to STEM lessons and activities, which helps make their subject more engaging and less formulaic for pupils. For example, the CPD has provided some primary school teachers with the confidence to deliver science lessons outdoors. These teachers report that this has been particularly beneficial for pupils because outdoor environments make science more engaging and less restrictive, improving children's capacity for more self-directed and exploratory learning:

> Even though we haven't got lots of space, we've got planters outside and a very small urban garden area …. it makes science part of real life and practical. This [project] ran alongside their curriculum to fully enrich what they're doing in science. It has been exciting.
>
> **Science leader**

Teachers in both secondary and primary phases report that their confidence is further developed by sharing and cascading learning acquired from CPD with colleagues. Teachers describe that opportunities to share how they approach their lessons and

investigations through internal meetings at their school and via partner school visits have increased their confidence in subject knowledge and the skills to lead activities. This, in turn, has led teachers to feel more motivated and enthusiastic about their subject:

> It's been exciting, motivating and inspirational. I have thoroughly enjoyed the training, and I feel as if I've become a better teacher [because of] it, and I feel as if the children have had a lot more exciting opportunities. I feel a lot more confident if people come to me and say I need help with this.
>
> **Teacher**

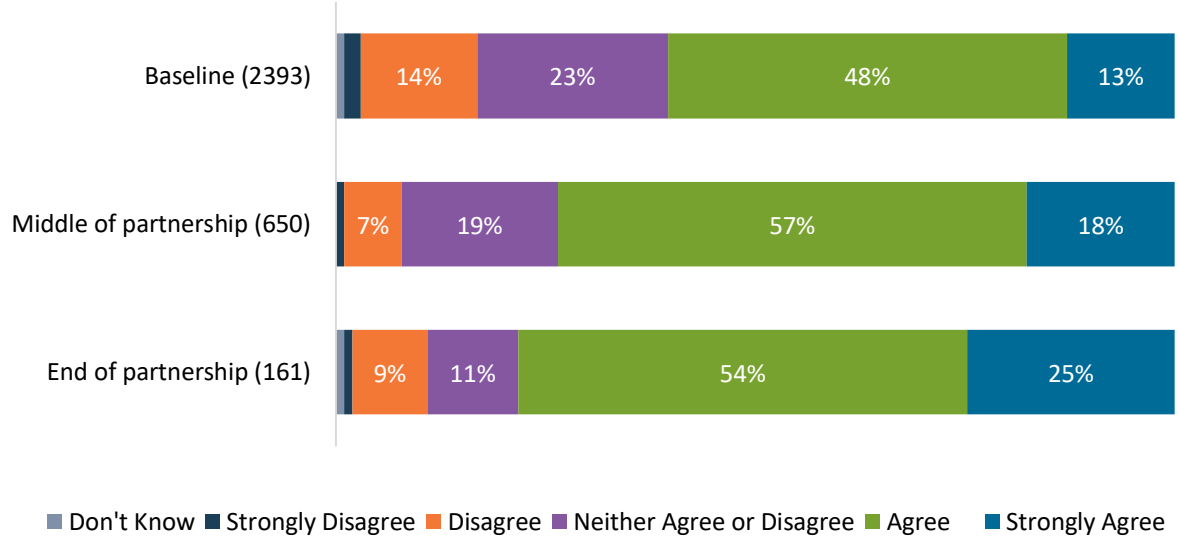
Lesson planning and assessment

Teachers report various positive impacts about how the partnership has supported them to enhance their lesson planning and assessment. Having access to high-quality resources for relevant STEM subjects and enrichment activities enables teachers to develop a deeper understanding of the structure of the STEM curriculum, which, in turn, supports effective lesson planning and assessment. Findings suggest that being part of an ENTHUSE Partnership enables teachers to have access to high-quality teaching resources (Figure 5):

– At the start of the partnership (baseline), three in five (61%) teachers strongly agree or agree that they have access to high-quality teaching resources for their subject.
– At the end of the partnership, nearly four in five (79%) teachers strongly agree or agree that they have access to teaching resources, representing an 18 percentage-point increase.
– At the end of the partnership, primary school teachers report larger increases in having access to high-quality teaching resources than secondary school teachers. However, secondary schools started at a higher baseline.[10]

[10] At baseline, half (50%) of primary teachers strongly agree or agree with the statement '*I have access to high-quality teaching resources for this subject',* compared with 81% of secondary teachers. After two years, 77% of primary teachers strongly agree or agree, while figures remain similar for secondary teachers.

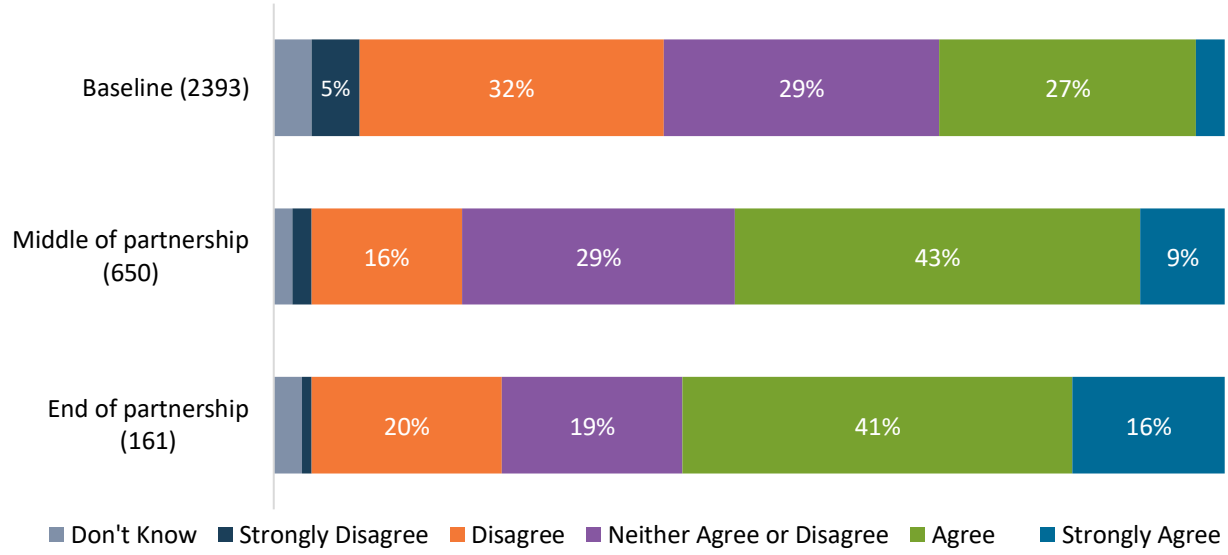
Figure 5: Extent of agreement with the teacher survey statement 'I have access to high-quality teaching resources for this subject'.



Similarly, there are increases in the proportion of teachers who have access to high-quality resources to support STEM enrichment after being part of the partnership (Figure 6):

– At the start of the partnership (baseline), less than a third (30%) of teachers strongly agree or agree that they had access to high-quality teaching resources.
– At the end of the partnership, 57% of teachers strongly agree or agree that they have access to high-quality teaching resources, representing a 27 percentage-point increase.
– Yet around one in five (20%) teachers disagree that they have access to STEM enrichment resources at the end of the partnership.

Figure 6: Extent of agreement with the teacher survey statement 'I have access to high-quality resources to support STEM enrichment'.

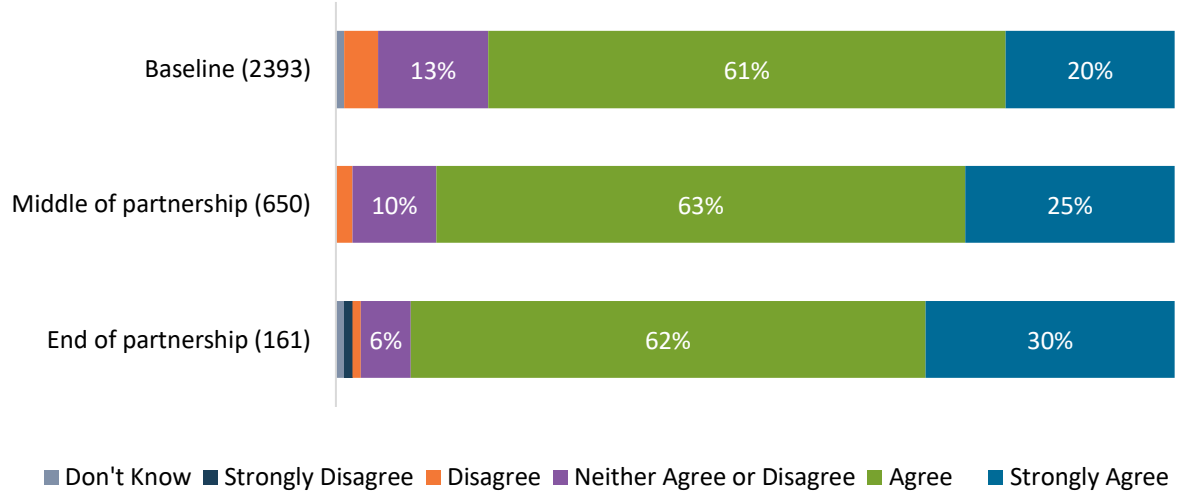


To effectively plan STEM lessons and assess pupils, teachers need to understand the curriculum structure for their subject. Prior to the partnership (baseline), most teachers report understanding the curriculum structure in their focus subject. Despite high levels of initial agreement, there is an increased understanding of the curriculum structure at the end of the partnership (Figure 7):

– At the start of the partnership (baseline), eight in ten (81%) teachers strongly agree or agree that they understood the rationale of how the curriculum in their subject is structured.
– At the end of the partnership, nearly all teachers (92%) strongly agree or agree with the statement, representing an 11 percentage-point increase.
– A higher proportion of primary school teachers agree with this statement at the end of the partnership than secondary school teachers. However, agreement among secondary school teachers was high at the start of the partnership.[11]

[11] 89% of secondary teachers strongly agree or agree with the statement *'I understand the rationale for how the curriculum in this subject is structured'*, compared with 77% of primary teachers. Two years after the ENTHUSE Partnership 94% of secondary and 91% of primary teachers strongly agree or agree.

Figure 7: Extent of agreement with the teacher survey for the statement 'I understand the rationale for how the curriculum in this subject is structured'.



A strong sentiment conveyed from interviews with senior leaders is that ENTHUSE Partnerships has enabled teachers and science leaders to acquire a variety of useful and sustainable resources to support them with their lesson planning and deliver more engaging STEM lessons. For example, one primary school describes being introduced to Explorify as a planning and retrieval tool, using it at the beginning of lessons and to stimulate discussion among children. TAPS (Teacher Assessment in Primary Science) is a further tool that some ENTHUSE Partnership primary schools have been introduced to via CPD sessions to support them with lesson planning and to assess children's 'working scientifically' skills on a termly basis.

> We introduced [TAPS] with the expectation that there's one done every term to assess the children's working scientifically skills. That obviously then should be feeding into the planning. So, there are lots of resources to help us plan more scientific investigations.
>
> **Science leader**

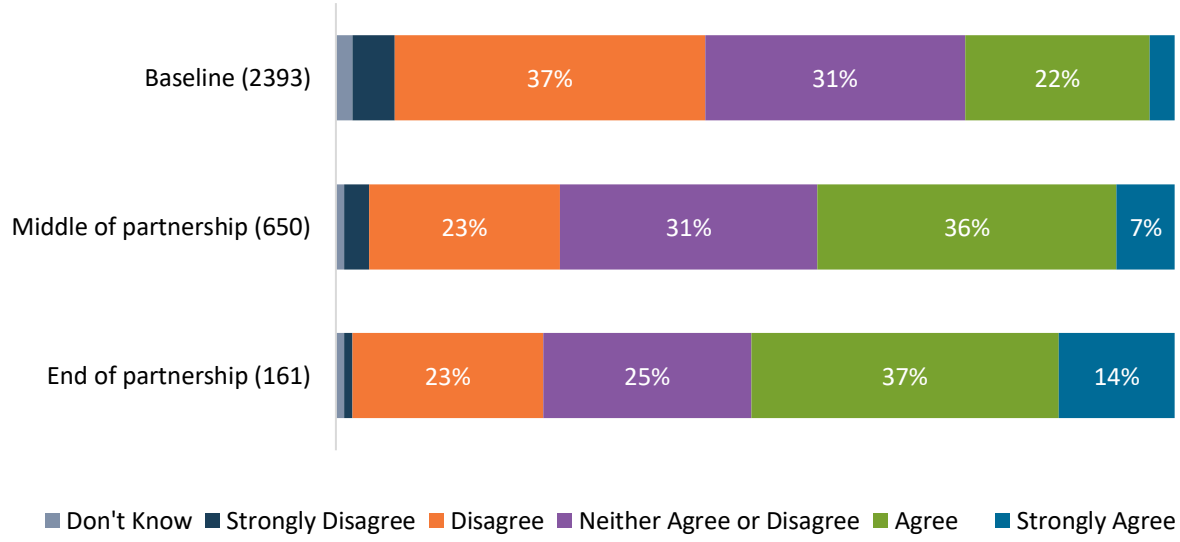
Understanding of STEM careers and study pathways

Participating in a partnership increases teachers' understanding of STEM careers and study pathways and, unsurprisingly, secondary school teachers are more knowledgeable than primary teachers. Teachers' knowledge about STEM-related further study increases after being part of a partnership (Figure 8):

– At the start of the partnership, a quarter (25%) of teachers strongly agree or agree that they had good up-to-date knowledge about STEM-related further study options.

– Primary school teachers reported being less knowledgeable than secondary teachers at the start of the partnership.[12]
– At the end of the partnership, half (51%) of teachers strongly agree or agree with the statement, representing a 26 percentage-point increase. Over three-quarters (77%) of secondary teachers strongly agree or agree that they are knowledgeable compared with 44% of primary teachers.
– Secondary teachers' agreement of knowledge about apprenticeships and technical pathways increased at the end of the partnership by 34 percentage points.[13]

Figure 8: Extent of agreement with the teacher survey for the statement 'I have a good up-to-date knowledge of STEM-related further study options.



ENTHUSE Partnerships also equip teachers with up-to-date knowledge about STEM jobs (Figure 9):

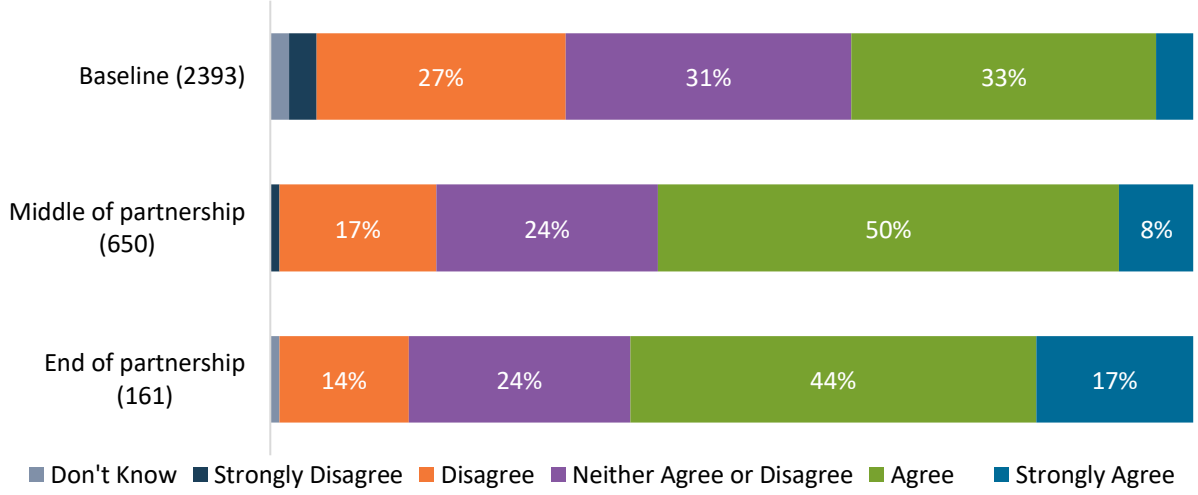
– At the start of the partnership, less than two in five (37%) teachers strongly agree or agree that they had good up-to-date knowledge of STEM jobs.
– There are differences by phase at the start of the partnership – three in five (58%) secondary teachers strongly agree or agree compared with just over a quarter (27%) of primary teachers.
– At the end of the partnership, around three in five (61%) teachers strongly agree or agree with this statement, representing a 24 percentage-point increase.

[12] At the start of the partnership, just 15% of primary teacher strongly agree or agree compared with 57% of secondary teachers.

[13] At the start of partnership, 43% of secondary teachers strongly agree or agree, which increased to 77% two years after the partnership.

– Primary teachers report greater knowledge increases than secondary teachers. However, less than half of primary teachers strongly agree or agree (44%) that they had good up-to-date knowledge compared with two in five (61%) secondary teachers.

Figure 9: Extent of agreement with the teacher survey for the statement 'I have a good up-to-date knowledge of STEM jobs'.

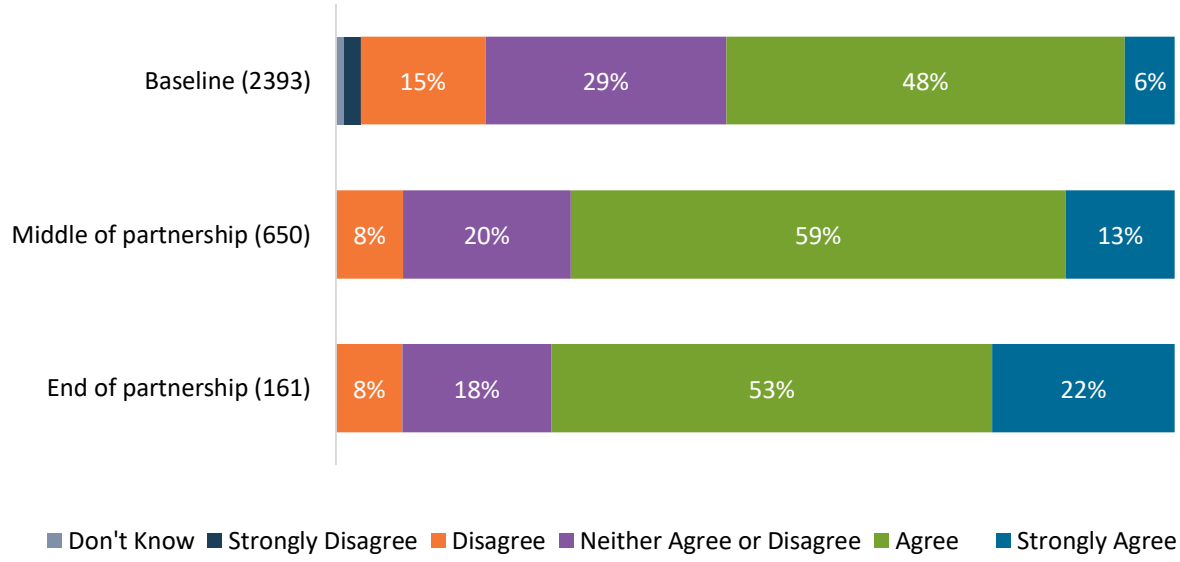


Being part of an ENTHUSE Partnership positively impacts teachers' confidence to make links to STEM jobs in their teaching (Figure 10):

– At the start of the partnership, just over half (54%) of teachers strongly agree or agree that they had the confidence to make links to a range of jobs in their teaching.
– Secondary school teachers were more confident than primary teachers at the outset of the partnership.[14]
– At the end of the partnership, three-quarters of teachers (75%) strongly agree or agree with the statement, representing a 21 percentage-point increase.
– Nearly all secondary teachers strongly agree or agree (94%) compared with 69% of primary teachers.

[14] 46% of primary school teachers strongly agree or agree compared with 70% of secondary teachers.

Figure 10: Extent of agreement with the teacher survey for the statement 'I am confident at making links to a range of jobs in my teaching'.

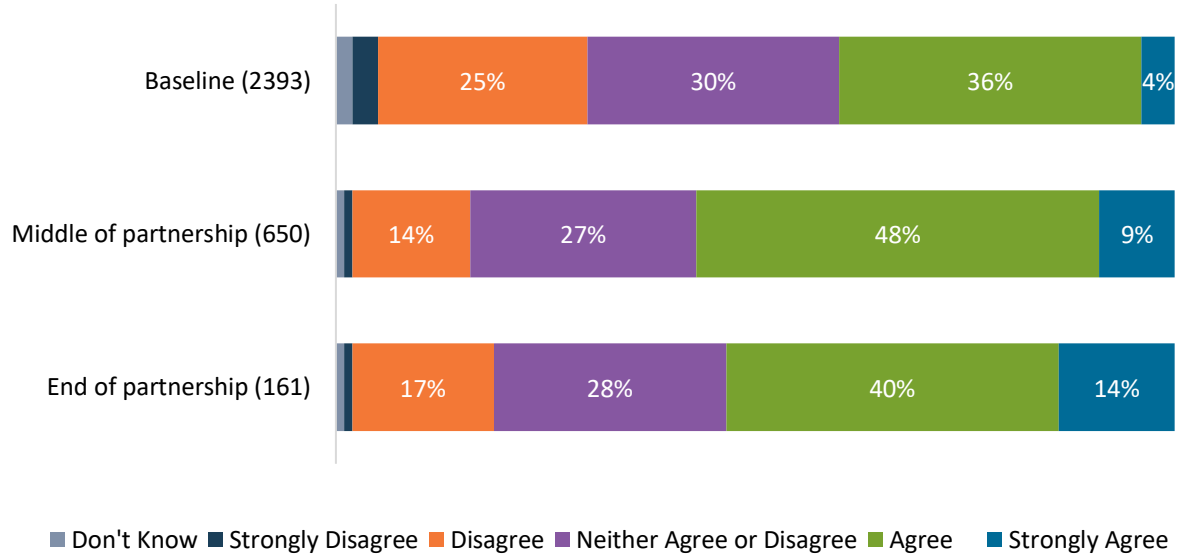


Teachers, secondary school teachers in particular, report improved employability skills knowledge due to being part of a partnership (Figure 11):

– At the start of the partnership, two in five teachers strongly agree or agree they had employability skills knowledge.
– Secondary school teachers demonstrate higher knowledge levels than primary teachers.[15]
– At the end of the partnership, over half (54%) of teachers strongly agree or agree, representing a 14 percentage-point increase.
– Nearly all secondary teachers (89%) strongly agree or agree that they have knowledge of employability skills, showing a 24 percentage-point increase. This compares with less than half of primary teachers (45%) but still represents a 19 percentage-point increase.

[15] 26% of primary school teachers strongly agree or agree compared with 65% of secondary teachers.

Figure 11: Extent of agreement with the teacher survey for the statement ‘I have good up-to-date knowledge of employability skills’.



Interviewees convey that the partnership CPD and enrichment activities with employers helps teachers acquire knowledge about STEM careers and study pathways and gives them the confidence to integrate this knowledge into their teaching and tailor careers advice to pupils’ particular interests:

> I will speak about people I've worked with, people I've met, to encourage career conversations with the students. You know, 'If you were really good at this part of physics, you could aspire to be an engineer at Arup', or ‘We had a building built here, this new building, is by BAM’.
>
> **Teacher**

> Teachers have been more able to talk about careers. Through CPD, teachers managed to improve their subject knowledge and confidence to talk to pupils about careers in STEM and encourage them to look at STEM career pathways.
>
> **ENTHUSE Partnership leader**

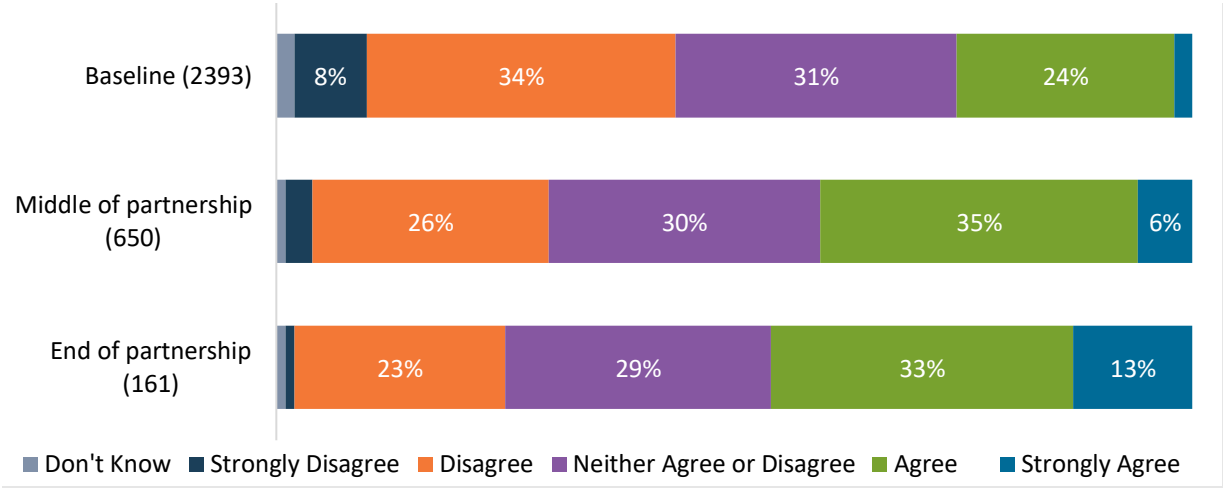
Employer and community engagement

Increasing opportunities for teachers to meet employers and industry experts both at school and in the community positively impacts their teaching skills and knowledge, which, in turn, increases pupils' interest in taking up such careers. Being part of a partnership enables teachers to provide pupils with opportunities to meet a range of different people who work in STEM roles (Figure 12):

– At the start of the partnership, one-quarter (26%) of teachers strongly agree or agree that they could provide opportunities for pupils to meet people who work in STEM.

– At the end of the partnership, nearly half (46%) of teachers strongly agree or agree with the statement, representing a 20 percentage-point increase.

Figure 12: Extent of agreement with the teacher survey for the statement 'I am able to provide opportunities for my students to meet people that work in science'.

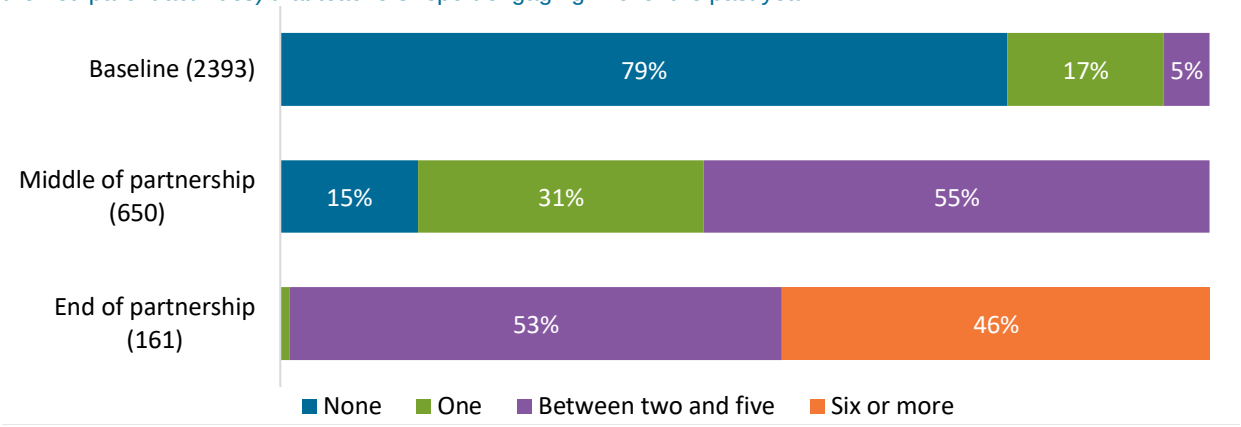


ENTHUSE Partnerships also create opportunities for teachers to facilitate local STEM community events that can involve parents and the wider community. These events have a positive impact on both pupils' and parental engagement in STEM subjects and the relevance to different jobs (Figure 13).

– At the start of the partnership, eight in ten (79%) teachers had not been involved in any educational community engagements in the last year.

– At the end of the partnership, all teachers had been involved in at least one community event, with nearly half (46%) engaging in six or more events.

Figure 13: Proportion of education engagements with the local community (e.g. community STEM events, STEM-themed parent activities) that teachers report engaging in over the past year.



Primary school leaders and teachers report that being part of a partnership has enabled them to extend their enrichment work with pupils and parents to have some impact on the whole community, via events such as science weeks and science fairs. Teachers describe how these events have celebrated the work pupils are doing more consistently and, thus, this is increasing interest and engagement in science both at school and at home. Pupils are being given the opportunity to showcase their projects in these celebration events, with prizes for each year group being a further stimulus to raise the profile of science and increase excitement.

> The science fair was the most impactful event because it was coming from the families and the children. And it enabled us to build on children's enthusiasm more.
>
> **Science leader**

Pupil impacts

Drawing on findings from the pupil and teacher surveys, together with insights from interviewees, participation in a partnership has a range of positive pupil impacts, including:

– Increased opportunities to participate in extracurricular enrichment activities.

– Increased enthusiasm and enjoyment in STEM subjects.

– Improved ability to make links between science and the everyday world.

– An increased belief that they can do well in STEM subjects.

– Improved understanding of STEM careers and further study pathways.

Participation in enrichment activities

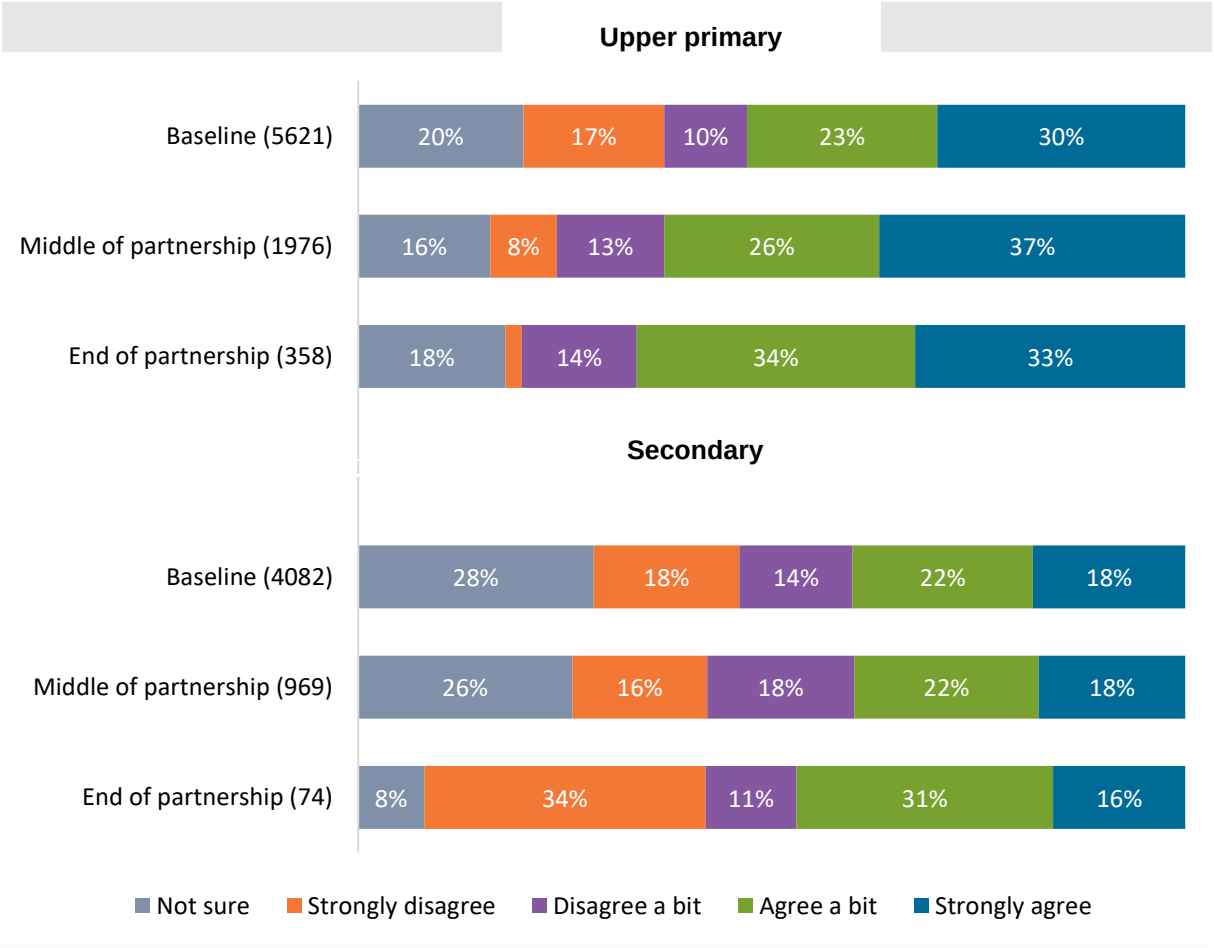
One of the main objectives of ENTHUSE Partnerships is to provide pupils with opportunities to participate in STEM enrichment activities. Corroborating teachers' views, survey findings show that both primary and secondary pupils perceive having more access to STEM enrichment activities over the course of the partnership (Figure 14):

– At the start of the partnership, a higher proportion of primary school pupils (53%) strongly agree or agree that they got the chance to participate in STEM activities than secondary pupils (40%).

– At the end of the partnership, there is a 14 percentage-point increase in the proportion of primary (67%) school pupils and a 7 percentage-point increase among secondary (47%) pupils who strongly agree or agree with the statement.[16]

[16] The increase in agreement among primary school pupils is significant ($p<.05$) but is non-significant for secondary pupils.

Figure 14: Extent of agreement with the pupil survey for the statement 'I get the chance to take part in STEM activities such as clubs and competitions.



Over the course of the partnership, there are slight increases in the proportion of primary school pupils who strongly agree or agree that they participated in STEM trips (e.g. to museums, workplaces and science fairs), while secondary pupils perceive taking part in fewer trips at the end of the partnership.[17]

Most senior leaders, science leaders and teachers report an increase in pupils' enthusiasm towards and participation in STEM enrichment activities since the start of the partnership. Interviewees describe how the CPD provided by ENTHUSE Partnerships has enabled them to focus on introducing more innovative STEM activities. For example: the Robot Wars inter-school competition held in STEM industry venues and gardening projects providing ingredients for school meals. CPD has also provided teachers with the skills to implement and run STEM clubs on a much larger and more sustainable scale, with most partnership schools now having a more diverse STEM enrichment programme than was the case before the partnership began.

[17] At the start of the partnership, 53% of primary pupils strongly agree or agree compared with 27% of secondary pupils. Two years after, 60% (+7%) of primary pupils strongly agree or agree compared with 18% (-9%) of secondary pupils.

> [Being part of an ENTHUSE Partnership] has allowed schools to support STEM clubs because some of them didn't have them in their schools and some of them had very small STEM clubs. So that's been a positive.
>
> **Adviser**

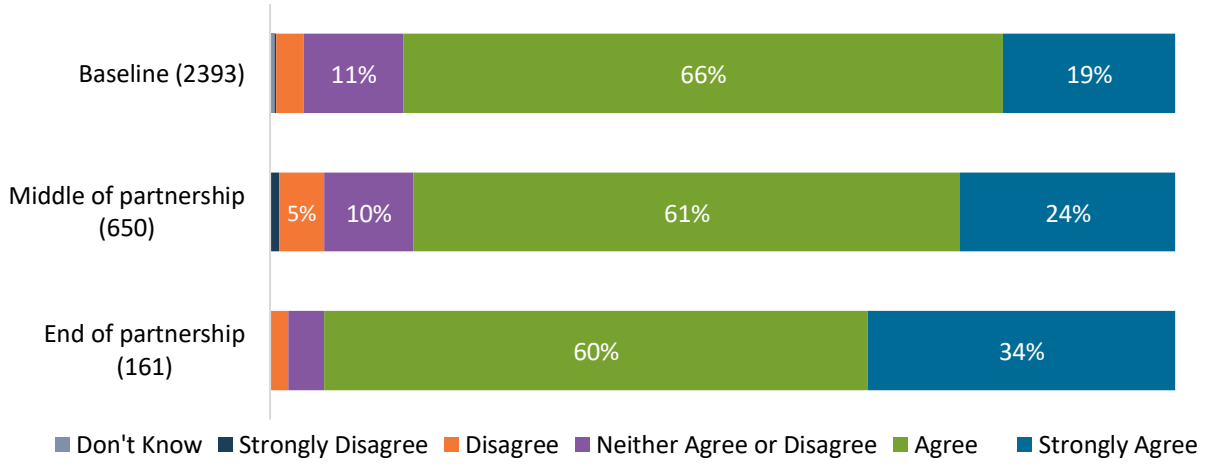
Enthusiasm towards STEM subjects

One of the key objectives of ENTHUSE Partnerships is to increase pupils' enthusiasm and spark curiosity in STEM subjects. Teachers report high baseline levels of pupil enthusiasm, particularly among primary school pupils[18], but small uplifts in enthusiasm, irrespective of school phase are still reported (Figure 15):

– At the start of the partnership, 85% of teachers strongly agree or agree that students were enthusiastic about their STEM subject.

– At the end of the partnership, 94% strongly agree or agree, representing a 9 percentage-point increase.

Figure 15: Extent of agreement with the teacher survey for the statement 'Students are enthusiastic about learning in this subject'.



Primary school pupils report small increases in their enjoyment at the end of the partnership, while enjoyment reduces among secondary pupils.[19] Findings are also mixed regarding pupils' motivation to want to learn more or study their STEM subject when they are older (Figure 16):

– At the start of the partnership, around 70% of primary school pupils strongly agree or agree that they would like to learn more about STEM when they are older compared with 51% of secondary pupils.

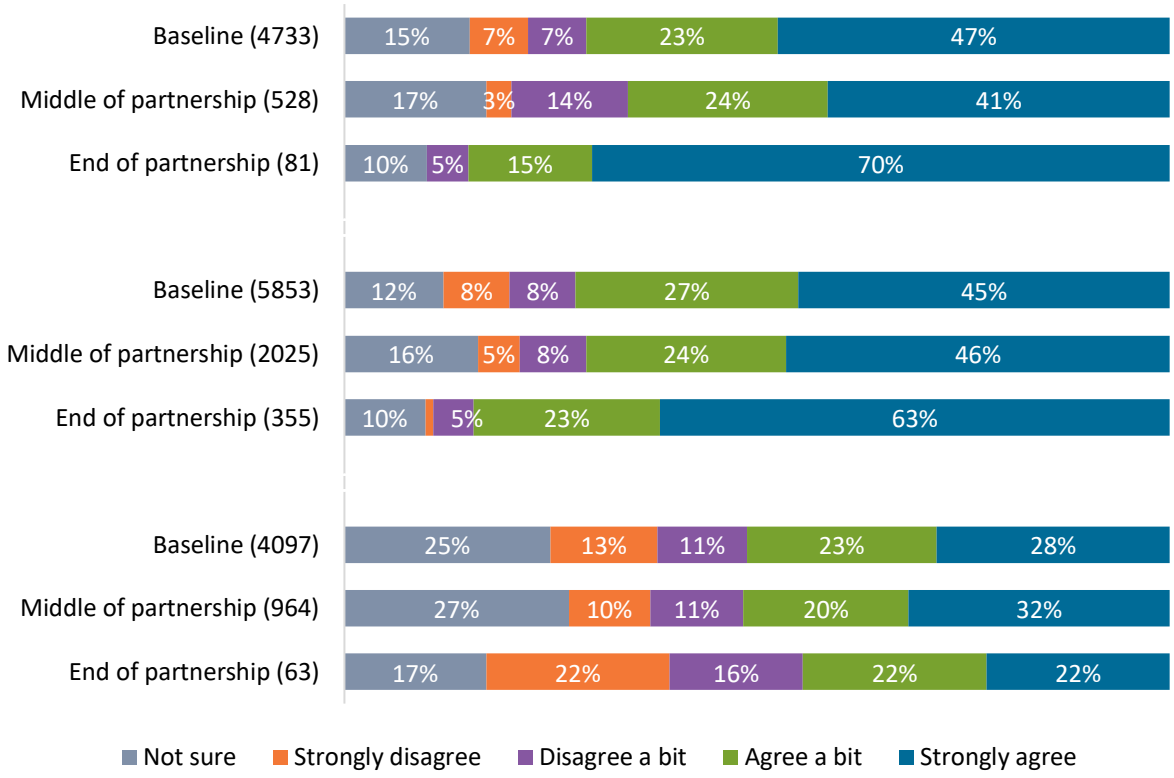
[18] At the start of the partnership, 92% of primary teachers strongly agree or agree compared with 70% of secondary teachers that students are enthusiastic in their learning. Two years after, 99% of primary teachers and 80% of secondary teachers strongly agree or agree with the statement.

[19] At the start of the partnership, 84% of lower primary, 82% of upper primary and 76% of secondary pupils strongly agree or agree that they enjoyed learning their STEM subject. Two years after 88% of lower primary, 81% of upper primary and 59% of secondary pupils strongly agree or agree with the statement.

– At the end of the partnership, 85% of primary school pupils strongly agree or agree with the statement, representing a 15 percentage-point increase. This compares with 44% of secondary pupils, representing a 7 percentage-point decrease.

These findings suggest that secondary pupils are starting to form ideas about their future subject and career choices and over time they decide that STEM subjects are not for them. The proportion of secondary pupils who are 'not sure' about whether they would like to study STEM subjects reduces after two years.

Figure 16: Extent of agreement with the pupil survey for the statement 'I would like to learn more about/study science, D&T, engineering, computing or maths when I am older'.



Most interviewees, including science leaders, technicians and employers report that pupils have been more enthusiastic about STEM subjects since starting the partnership. In contrast to the pupil survey data, secondary schools' partnership interviewees also report that their pupils are more interested in STEM subjects and more students are opting to study STEM subjects since the start of the partnership. For example, science technicians in one secondary school describe how the introduction of more practical STEM experiments both during lessons and enrichment activities has contributed to a 'buzz' in school, where they hear pupils talk excitedly among themselves about the activities, they have participated in. Technicians attribute increased enthusiasm to pupils developing a more thorough awareness that science is all around them, which makes it more meaningful for them:

The children are talking about it more. And just realising that science doesn't have to be boring…you know, everything we do in and around us is science. You're moving your pen across the desk, there's friction. And 'You dropped your pen on the floor, we've got air resistance.' It has been great fun, and the kids have been loving it.

Secondary school science technician

Some interviewees further describe how the ENTHUSE Partnership programme gives pupils opportunities to share their learning and enthusiasm for STEM subjects with a wider cohort of pupils and they are more willing to do this in their own time. For example, Junior STEM Ambassadors in one primary school organised their own STEM activities and quizzes for younger pupils to take part in, resulting in them cascading their newly acquired knowledge and excitement for STEM throughout the school.

Introducing engaging experiences via partnership enrichment activities such as new STEM club projects, outdoor science lessons, planetarium visits and science fairs (Appendix 1) are perceived by most secondary and primary school teachers and leaders to be the key to sparking pupil engagement in STEM subjects. Ensuring a competitive element to activities is also perceived to be particularly effective in harnessing pupils' enthusiasm and commitment to enrichment activities, according to some secondary school science leaders. The partnership allows teachers across all school phases to introduce pupils to experiences they may not have had before, broadening their horizons and awareness of STEM subjects in a real-world context. This is particularly the case for more disadvantaged pupils who are less likely to have access to experiences outside of their immediate locality. Opportunities to interact with local employers through visits and sponsored competitions are perceived to be particularly beneficial by science leaders in both settings:

We want every child to have an opportunity to grow something. Many [children] don't have gardens of their own in this school. Even though we haven't got lots of space, we've got planters outside and a small urban garden area with larger planters, so we've got one class growing all sorts of carrots and radishes.

Science leader

We want to make sure that they're getting involved in programmes like this because often what we realise is that it's the real-life application that just makes it click for children. It's about experiences.

Science leader

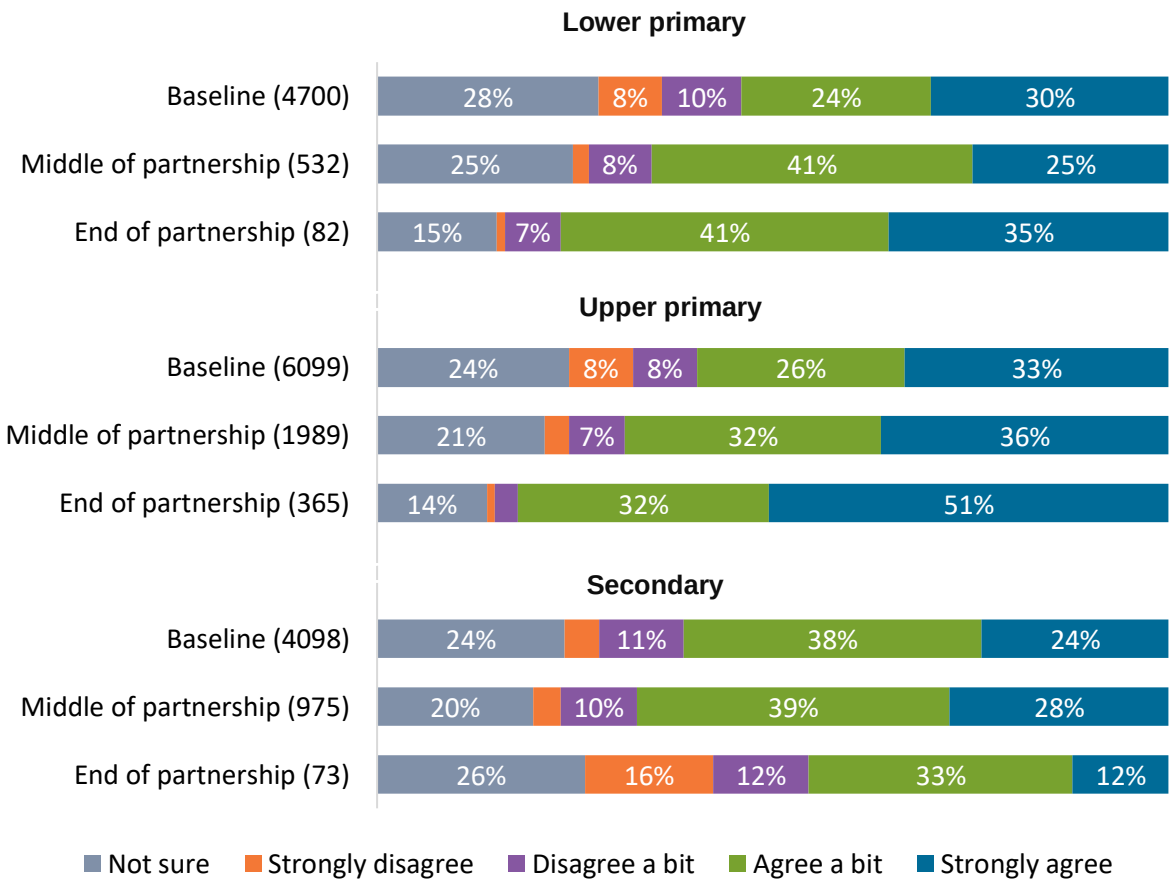
Making links between science and everyday life

There are mixed findings about the extent to which pupils agree that their teachers make links between science and everyday life to support learning, with more positive findings reported by primary school pupils than secondary pupils (Figure 17):

– At the start of the partnership, a similar proportion of primary school and secondary pupils strongly agree or agree that their teachers use stories and examples of real-life problems to help them learn (primary: 59%; secondary: 62%).

– At the end of the partnership, four in five primary school pupils (83%) strongly agree or agree, representing a 24 percentage-point increase. This compares with less than half (45%) of secondary pupils, demonstrating a 17 percentage-point decrease.

Figure 17: Extent of agreement with the pupil survey for the statement 'We read stories and hear about real-life problems to help me learn in STEM subjects.



Similarly, a higher proportion of primary school pupils than secondary pupils perceive that what they learn in STEM subjects is important to everyday life:

– At the start of the partnership, around 70% of both primary and secondary school pupils strongly agree or agree that what they learn in STEM subjects is important to everyday life.

– At the end of the partnership, nine in ten primary school pupils (91%) strongly agree or agree, compared to just over half of secondary pupils (51%). This demonstrates a 19 percentage-point increase for primary pupils, but a corresponding 19 percentage-point decrease for secondary pupils.
– At the end of the partnership, the proportion of secondary pupils who were unsure about the importance of STEM subjects in everyday life increased from 19% at the start of the partnership to 38%.

These findings suggest that secondary students who have decided that they are unsure of whether STEM subjects are for them are less likely to see the relevance to their everyday lives.

Interviewees describe that more practical-based STEM lessons and enrichment activities support pupils to develop a greater understanding of the connection between STEM and the real world, with practical 'in the moment' activities perceived to be particularly impactful for primary school pupils. For example, one primary school teacher describes how a practical gardening project enabled pupils to observe and contribute to the growing of plants and vegetables in the garden, rather than about the plant lifecycle from a teacher in a classroom environment:

> I discovered that any activities where I did use the outdoors excited [pupils] and really kept them motivated….so just by being outside and doing more outside science activities, it was beneficial to their learning… it makes science part of real life.
>
> **Science leader**

Children with additional needs particularly benefit from practical investigations and enrichment activities, according to some secondary school teachers. Teachers report how they are observing pupils enjoying this more interactive approach to STEM. Furthermore, they become more excited and enthusiastic about their lessons, which is more conducive to their ability to learn:

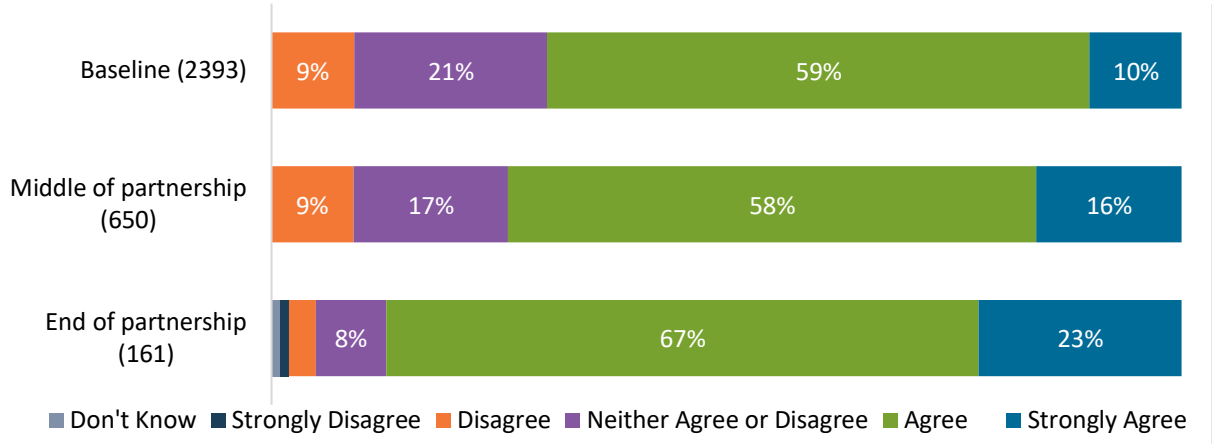
> [Pupil premium children] and more vulnerable children have come along to the science club. They have become a lot more positive towards science and a lot more interested.
>
> **Teacher**

Succeeding in STEM subjects and careers

There are indications that being part of a partnership supports students to believe that they can do well in STEM subjects (Figure 18):

– At the start of the partnership, over two-thirds (69%) of teachers strongly agree or agree that students believe they can do well.
– At the end of the partnership, 90% of teachers strongly agree or agree, representing a 21 percentage-point increase.

Figure 18: Extent of agreement with the teacher survey for the statement 'Students believe they are capable of doing well in STEM subjects.



Insights from the pupil surveys show that primary school pupils' perceptions of self-belief that they can do well in STEM subjects increase over the course of the partnership for primary, but decrease among secondary pupils:

– At the start of the partnership, around three-quarters of primary (77%) and secondary (73%) school pupils strongly agree or agree that they can do well in STEM subjects.

– At the end of the partnership, nearly nine in ten (88%) primary pupils strongly agree or agree that they believe they can do well in STEM subjects, representing an 11 percentage-point increase. In contrast, secondary school pupils' agreement decreases by 11 percentage points to 62%.

The pupil survey also explores their self-belief towards getting a STEM job. The results show differences between primary and secondary school pupils' perceptions:

– At the start of the partnership, two in five (60%) primary pupils strongly agree or agree.

– At the end of the partnership, 84% of primary pupils strongly agree or agree, representing a 24 percentage-point increase.

– At the start of the partnership, nearly three in five (57%) secondary pupils strongly agree or agree that they were the kind of person that could work in STEM.

– At the end of the partnership, this reduces to 50%, demonstrating a 7 percentage-point decrease in secondary pupils' perceptions of self-belief.

For some secondary school pupils, science leaders and teachers report that participating in STEM clubs and competitions has developed key skills needed for success in STEM subjects. For example, developing problem-solving and leadership skills in projects such as the Unilever Bright Future Inspire project.

Other teachers attribute improved GCSE exam results in STEM to the teachers' CPD input on the effective teaching of separate science subjects. (Appendix 1)

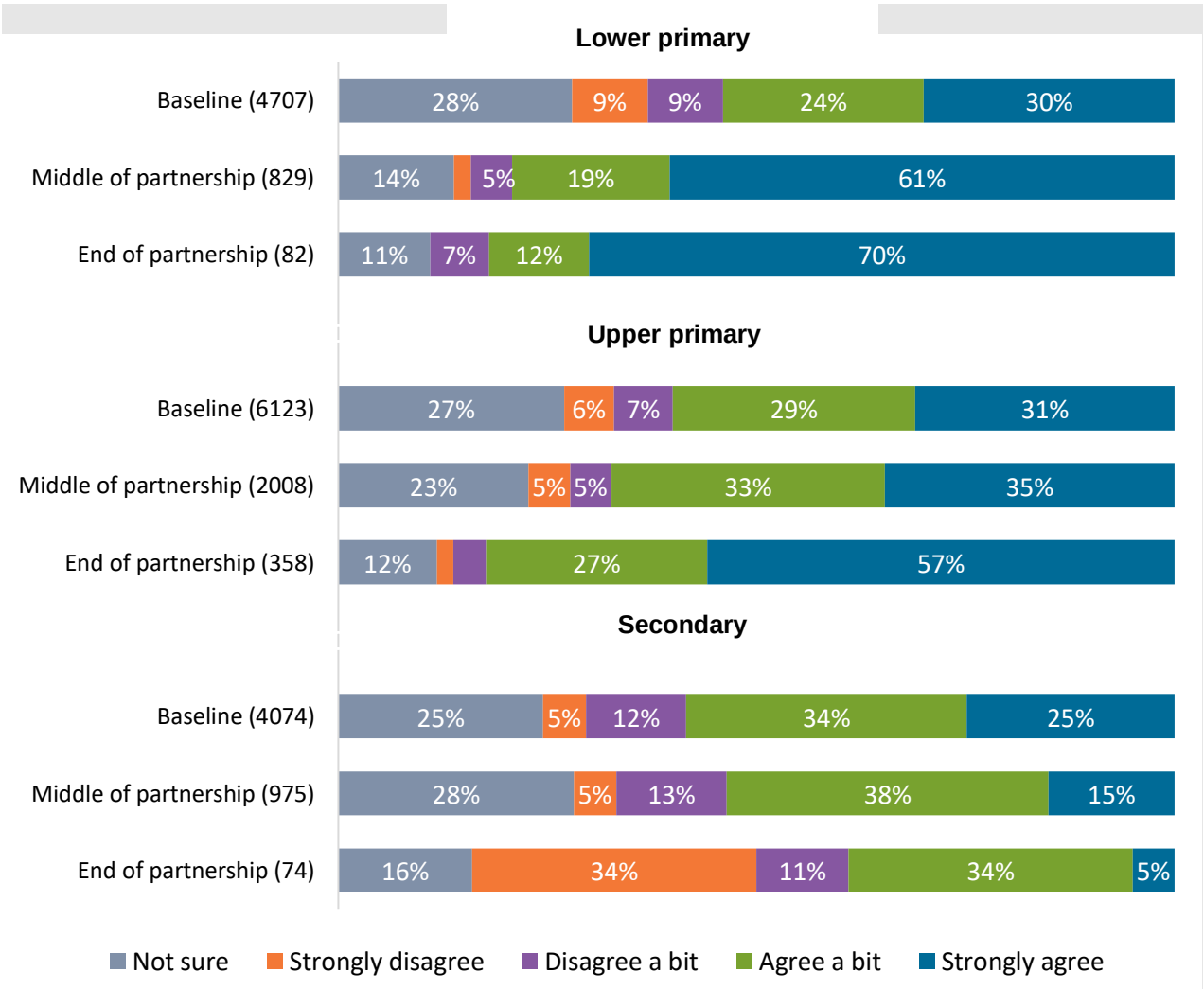
Knowledge about STEM careers and study pathways

Equipping pupils with accurate knowledge of STEM careers and study pathways is important to enable them to learn about the different roles available and make informed decisions about their next steps. Providing opportunities for pupils to meet STEM employers is a key aim of the partnership to help pupils acquire knowledge about what STEM roles involve and the types of careers available. Pupils' agreement that they learn about different STEM jobs increases among primary school pupils over the course of the partnership but decreases among secondary pupils (Figure 19):

– At the start of the partnership, around three in five pupils (primary: 60%; secondary: 59%) strongly agree or agree that they learn about different STEM jobs.

– At the end of the partnership, 84% of primary school pupils strongly agree or agree, representing a 24 percentage-point increase. In contrast, secondary pupils' agreement decreases to 39%, a 20 percentage-point reduction.

Figure 19: Extent of agreement with the pupil survey for the statement 'I learn about jobs that people do'.



There are slight increases in primary school pupils' agreement that they meet people who work in STEM at their school, while agreement among secondary pupils decreases over the course of the partnership:

– At the start of the partnership, a higher proportion of secondary school pupils (58%) strongly agree or agree that they met people who work in STEM at their school compared to primary school pupils (51%).
– At the end of the partnership, there is an increase in the proportion of primary pupils who strongly agree or agree (62%) by 11 percentage points, while agreement among secondary pupils decreases (52%) by 6 percentage points.

Secondary students' agreement that they learn about diverse ways to train in STEM, including university and college courses, also decreases over the course of the partnership. At the start of the partnership, over half (54%) of secondary pupils strongly agree or agree, which reduced to one in five (19%) at the end of the partnership (a 35 percentage-point decrease).

The general trend in decreased agreement among secondary pupils over the course of the partnership could be due to several reasons. There is a much-reduced sample of secondary pupils who responded to the final survey and the sample could be biased towards those who hold more negative perceptions and those who have made decisions not to pursue STEM study options. It is also not possible to definitively attribute student perceptions to the partnership as they will have been exposed to a variety of different STEM activities and recall might not be accurate. It could also be the case that secondary schools found it more challenging than primary schools to organise opportunities for students to meet STEM employers, find out about careers, and study pathways.

Most Advisers interviewed support this view, identifying that collaboration with employers is difficult for schools and partnerships because schools lack knowledge about STEM employers and do not have established employer networks. Many secondary schools may also have limited time and capacity to set up partnerships with employers due to already extensive workload commitments. As an employer with existing links with schools, Arup Engineering acknowledges how challenging it is for schools to identify employers to partner with, even when they have access to the STEM Ambassadors network, simply due to a lack of knowledge, time and capacity to make those connections:

> Multi-academy directors need to know who the companies are, within their catchment area and approach them and go, 'Look, we've got this funding', or whatever their need is, 'Can you help us?'. When you've got something like the STEM Ambassadors network, sifting through 100s of pages doesn't really help.
>
> **Arup Engineering**

Despite the barriers, where there is employer involvement, interviewees describe the positive impact it has on teachers and pupils. Some senior leaders, science leaders and employers perceive that employer-led activities, for example, those identified in

case studies such as the Unilever Bright Future Inspire project at the Greenbank ENTHUSE Partnership and the Robot Wars competition at the President Kennedy Partnership, leads to an increase in STEM career aspirations among pupils who may not have previously been aware of the possibilities open to them:

> It's more about setting the kids up with the ability to know that these things can happen [for them]. It might lead them to a career with us, it probably won't, but if it does, that's brilliant. If it doesn't, they've got the skills that will get them into [a STEM career].
>
> **Arup Engineering**

Employer in-kind contributions via time and resources are invaluable support for ENTHUSE Partnerships. For example, Arup Engineering has supported the President Kennedy Partnership by designing the Robot Wars project and by delivering training and advice to teachers to roll out the project. The company has also helped to run the inter-school competition and source appropriate STEM industry venues to showcase the pupils' work. Senior leaders are confident that the design and building of robots across all eight schools in the partnership would have been impossible to achieve without Arup's idea to use 3D printers and accessible 'off-the-shelf' software. The manufacturing and technical expertise Arup provided was essential for the project's success, as was the free support Arup offered to teachers throughout the project. (Appendix 1)

> Pupils have had a once-in-a-lifetime opportunity and have used their STEM skills and have achieved something. It gives both enjoyment and something practical that they can take further on into their life.
>
> **Science leader**

Furthermore, teachers report that pupils, including previously less confident ones, are more likely to demonstrate a better understanding of how STEM subjects can lead to a viable career after participating in partnership enrichment activities:

> Children who aren't the ones who would always do everything in school and always get picked. They are realising that science and STEM careers could be for them and you know, some of them have been like, 'I never thought I'd want to do this'.
>
> **ENTHUSE Partnership Lead**

School and partnership outcomes and impacts

Drawing on the depth interviews and the documentation review, a range of positive school and partnership outcomes are identified from being part of a partnership, including:

– Increased profile of STEM subjects in primary and secondary schools.
– Increased collaboration and knowledge transfer between primary and secondary partner schools.
– Stronger links with regional networks/local delivery partners.
– Sustainability of some partnerships beyond the funding period.

Raised profile of STEM in schools

Most interviewees report that the profile of science and other STEM subjects in their school has grown since being a part of a partnership. They describe how staff CPD creates enthusiasm towards and a greater understanding of STEM subjects, which positively impacts their teaching practice and pupil experience. Science leaders and teachers view the CPD as inspirational, which has led to the introduction of STEM clubs in primary and secondary schools on a larger scale than before the partnership. The introduction of more STEM enrichment activities helps inspire and motivate pupils to engage with STEM subjects in the classroom:

> I would say that science is getting a bigger profile, it's getting a bigger slice of the [school's] time. And there is more commitment to it.
>
> **Adviser**

Some school leaders describe how enthusiasm towards STEM subjects in schools, generated by CPD, has translated into more innovative teaching practices both within and beyond the classroom. Senior leaders see the impact of this for the school and on pupils, including increased interest towards studying STEM subjects at GCSE and 'A' level. (Appendix 1) Due to these indicators of success, science leaders report being even more committed to raising the profile of STEM subjects:

> I think science is a lot more exciting and our school is a lot more enriched now. I feel confident that our planning and our assessment are a lot better. I feel as if we're doing things outside the box.
>
> **Science leader**

Increased collaboration across partner schools

The number and quality of collaborative partnerships among schools, science leaders, teachers, employers, community organisations, STEM education companies and parents have increased since the start of the partnership. Examples of collaborative activities facilitated by ENTHUSE Partnerships include:

- **Partnership-wide conferences and celebration days** – The Greenbank partnership (Appendix 1) hosted a STEM Challenge Celebration Day as part of Science Week – 20 pupils from each school in the partnership attended the enrichment day, met people from industry and did hands-on STEM activities.
- **STEM 'Taster' days** – Secondary schools in one partnership visited primary schools in the partnership to provide 'tasters' of the secondary school science curriculum and ran a 'STEM Fest' with activities for schools.
- **STEM Fairs** – Individual primary schools in the Pokesdown and President Kennedy partnerships (Appendix 1) hosted STEM fairs that focused on community collaboration and promoted parental involvement in STEM competitions and activities.
- **STEM experiences and visits** – The Greenbank partnership (Appendix 1) is planning to fund Operating Theatre Live for all schools within the partnership. Ten pupils aged 9–18 from each partnership school will attend the one-day workshop that includes a real medical operating theatre in the school. Pupils work with a medical anatomist to practise surgical techniques and other activities aligned with the science national curriculum. Greenbank School also hosted 'escape room' activities in collaboration with another school in the partnership which did not have a STEM club to share resources and costs.
- **Train the Trainer sessions** – The Greenbank partnership leads school-run training sessions for the Rocket Club activity for STEM clubs. This enables all the partnership schools to host the same activity. President Kennedy ran similar sessions for Robot Wars both for partnership schools and other schools beyond the partnership, which included a special school.
- **Peer-to-peer science days** – Schools from one partnership collaborated to deliver peer-to-peer specialist subject days with a sub-set of GCSE and 'A' level Biology students taking part in practical investigations together. The partnership also coordinated inter-school taster days for 'A' Level Chemistry, Biology and Physics.
- **Employer-led STEM projects** – The partnerships have pooled resources to host in-house competitive STEM club activities in collaboration with employers. This includes Robot Wars as well as 'off-the-shelf' employer projects and challenges, such as the Unilever Bright Future Inspire project and the Institute of Engineering and Technology Faraday challenge Days.
- **Enrichment days** – Using Practical Action 'Beat the Flood' resources, Greenbank School ran an enrichment day that focused on climate change and flood defences aiming to increase STEM knowledge and transferable skills such as teamworking and problem-solving skills. Similar enrichment days have been hosted by other partnership schools.
- **'Meet the scientist' career sessions** – Pokesdown partnership (Appendix 1) hosted a 'meet a local scientist' career session designed for Key Stage 2 pupils. Scientists visited schools to talk to them about their jobs and routes into STEM

careers. Other partnerships organised online conversations with scientists working in the space industry.

– **Technician network** – Greenbank partnership established a network for science technicians to collaborate and share information and improve the quality and delivery of science. This has grown to include technicians in schools outside the partnership who meet termly.

Both primary and secondary school teacher interviewees describe how the collaboration with other partnership schools and the pooling of resources has improved their ability to deliver effective STEM lessons and enrichment activities. This way of working creates a 'snowball effect' to share best practice whereby CPD, knowledge and learning are cascaded throughout the partnership, allowing schools to adapt shared practices to fit their unique circumstances. The success of these collaborations between partnership schools has led to increased sharing of enrichment activities. Other lead schools describe how they have hosted training for nearby schools, which do not have the time and budget to travel for training:

> We visit other schools and see what equipment they've got, what setup they've got. Seeing other schools gives us ideas like 'I could do that. I could resource that'. So, I think it has an impact across the schools.
>
> **Early career teacher**

Schools that are not part of a larger Multi-Academy Trust (MAT) describe their isolation and limited connections with other schools. Therefore, they view the opportunity to network with other schools in their geographical area as a significant benefit of the partnership network:

> We are not in any Trust, so we don't have that group sharing of ideas at any point or MAT inset days together where you can share these things. Having that opportunity to go and speak to other schools, look at what they're doing, and go, 'Oh, that's great. Maybe we should be doing that' has been great and invaluable.
>
> **Science leader**

Most schools perceive that having an Adviser and someone who can coordinate the partnership networking activities has helped to guide them to maximise collaborative opportunities within the Partnership. Schools welcome the signposting that the Adviser provides to the wide range of STEM enrichment activities available and advice about which activities will be most beneficial for their circumstances.

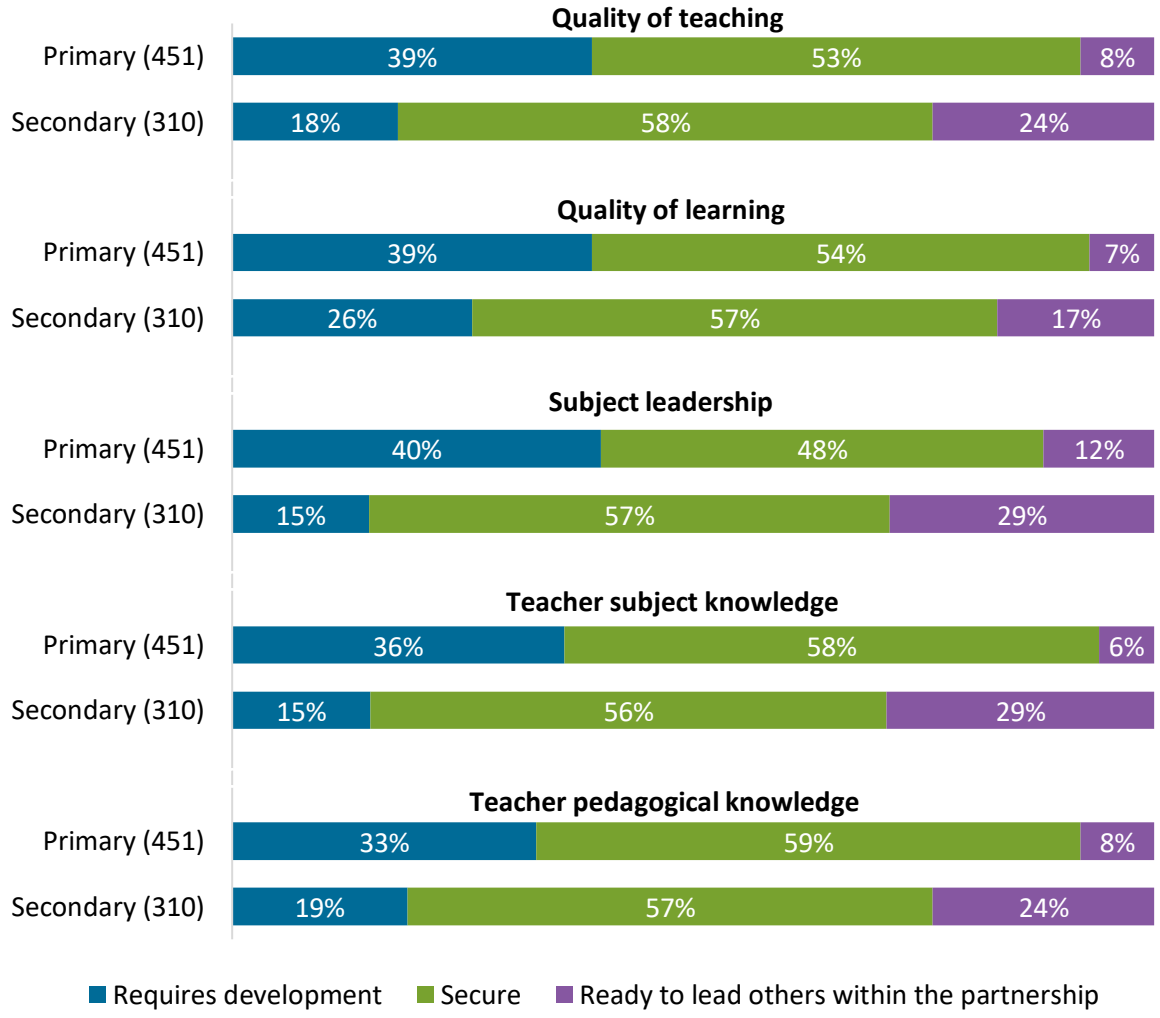
Schools value opportunities to share ideas and perceive this as one of the main reasons for remaining in the partnership beyond the Partnership funding period. Schools can share knowledge and benefit from economies of scale when attending CPD and running school excursions. They can also share resources and expertise, allowing schools to focus on the CPD that will be of most benefit to them, saving on cover time and costs:

> Through our support, [one school] grew their network, invited other schools in, had competitions, STEM Ambassadors. It was a real whirlwind.
>
> **Adviser**

Strengthened leadership in STEM subjects

Responses to the school survey at the outset of the Partnership highlight differences in perceptions between primary and secondary schools about their readiness to lead others in the partnership for quality of teaching, teacher subject knowledge, pedagogical knowledge, the quality of learning and subject leadership. Across all leadership areas, a higher proportion of primary school leaders perceive that improvements in leadership are needed compared with secondary school leaders (Figure 20).

Figure 20: School leaders' perceptions about the readiness for partnership schools to lead across a range of areas at the outset of the partnership.



School leaders were not required to complete a follow-up survey, which means it is not possible to quantitatively document changes about leadership in STEM subjects. However, insights from interviewees and the documentation review suggest that

being part of ENTHUSE Partnerships has strengthened leadership in STEM subjects. Science leaders report that they have benefitted from network meetings to share best practice and improved their confidence to plan and assess STEM subjects because of the CPD, which they have then cascaded to other teachers in their setting. Science leaders also perceive that the CPD has given them the space to innovate.

Science leaders in the President Kennedy Partnership attended locally designed training to become facilitators, to cascade learning to other teachers in the partnership and run in-house training courses to save time and resources. Consequently, secondary school leaders in particular report that their ability to lead their team and foster a culture of learning in their schools has been strengthened. Another science leader describes how they were able to attend an intensive training course at STEM Learning to support their aspiration to become a head of department, a course they would not have been able to do without the ENTHUSE funding. This course led to the science leader having the confidence in their knowledge and abilities to strive for the next step in their career, inspiring them to stay and develop within the profession. Overall, leaders view the CPD as important in helping them to enhance their leadership skills which is then cascaded to other staff:

> I'm currently a deputy science leader, aspiring to be a head of department. And I went on CPD at [college]. It was quite a heavy course, it was all paid for, it was an expensive course, but it was wonderful. I could bring back all [the learning back] to the department. It's really helped me in my own career progression and honestly, I'm just so thankful for that.
>
> **Teacher**

> I feel as if the CPD has helped me become a better science leader and I can move our subject on further in school and inspire more children.
>
> **Science leader**

Sustainable partnerships

Some schools report that plans for sustaining the partnership activities beyond the funding period are in place. For example, President Kennedy School has trained teachers to be facilitators of CPD sessions so that learning can be cascaded throughout The Futures Trust schools and senior leaders have committed to setting aside time for teachers to work on projects by arranging cover for their release time wherever possible. The three case study partnerships perceive that the most sustainable activities are partnership-wide meetings held termly online and face-to-face and collaborative events with different schools' STEM enrichment activities (e.g. science weeks and science fairs). These activities are also identified as being the most cost-effective, which can be sustained with a pooling of existing resources.

Most of the interviewees are motivated to sustain the enrichment activities initiated by the STEM clubs because of the excitement and enthusiasm they are generating among teachers and pupils. They also see emerging impacts and improvements on

STEM teaching practice and pupils' interest in STEM subjects post GCSE and 'A' level:

> It's created a legacy. And I think schools see the importance of it. I know we've prioritised it here at the school and continue to prioritise it because of the impact that it can have on students.
>
> **Senior leader**

The success of the CPD and subsequent Robot Wars STEM club activity, led by Arup Engineering at the President Kennedy Partnership is an example of where one idea and investment in resources (Robot Wars programme and 3D printers) leads to a sustainable project for subsequent year groups and new schools to take part in. Yet, it should be noted that this relationship was developed by partnership schools, following an initial introduction by the lead school and was not facilitated by STEM Learning.

Teachers already trained in delivering the Robot Wars by Arup will train teachers in the new schools to deliver the STEM club activity, with President Kennedy taking the lead in ensuring learning is disseminated and that they have access to resources. This is made possible through the continued involvement of The Futures Trust, a MAT participating in the partnership with the ability to oversee the coordination of the project across their schools.

The experience of running Robot Wars and the spotlight on STEM careers in the Midlands region has encouraged The Futures Trust to approach more regional employers, such as Caterpillar. This has enabled more schools outside of the President Kennedy Partnership to access further funding to purchase additional 3D printers and equipment.

Building on their initial success The Futures Trust and the local delivery partner describe how they have cascaded a STEM CPD programme to over 50 teachers in 20 schools.

> Beyond the funding period, we will still be able to sustain the running of Robot Wars and that's mainly because the bulk of the money that we spent from the ENTHUSE Partnership was in setting it up, so it would be sustainable.
>
> **Arup Engineering**

> We put in place a structured CPD programme for all the new schools that are joining Robot Wars for the first time this year. So that they could learn how to use the software, they could learn how to use the 3D printer and learn about the mechanics of the robots.
>
> **Science leader**

Indicators of ENTHUSE Partnership success and sustainability

Ensuring partnerships can maximise their funding to achieve a wide range of sustainable school, teacher and pupil benefits is influenced by several different indicators of success and overcoming shared challenges including:

- **ENTHUSE Partnership funding** over a focused period, which partnerships have the flexibility to use to meet needs, helps partnerships to provide **dedicated time and resources** to plan activities and foster links with partnership schools and wider stakeholders including employers and careers advisers.
- **A clear vision for the partnership** with guidance from an **experienced Adviser** who has strong links to STEM Learning and local employers.
- **Establishing strong senior leadership** to foster and sustain **school and employer collaborations**.
- **Matching school and employer priorities** to ensure all parties can benefit.
- **Tailored CPD for staff** via STEM Learning and local provision to ensure different training needs can be fully met.
- **Bespoke enrichment activities** for pupils to encourage them to consider further STEM study and careers.
- **Securing employer co-funding and in-kind contributions** to help develop STEM clubs and competitions, industry placements for teachers and work experience for pupils.
- **Streamlined monitoring, evaluation and reporting processes** to reduce the administrative burden on staff.

Funding and resources to plan and deliver activities

The funding provided as part of the ENTHUSE Partnerships is seen by interviewees to be critical to the success of the partnership. Many interviewees convey that they would not have been able to run CPD for staff and develop enrichment activities for pupils without the funding. Interviewees also emphasise the importance of the support from Advisers in helping them decide how best to allocate their funding and resources to most effectively meet their partnership objectives. The ENTHUSE Partnership funding helps to purchase equipment to host enrichment activities for pupils, alongside employer-funded equipment, and staff training to run the activities and use the equipment. Funding also contributes to the cost of cover for staff to attend training and support enrichment activities during school time. Physical resources include equipment for science labs and magnifying glasses through to 3D printers and rocket building kits.

Interviewees also value free online resources, for example from The Ogden Trust, the STEM Learning Explorify website and TAPS tool and planassessment.com.

Advisers recommend these to schools to support and improve their existing science lessons when time and resources are scarce:

> I think another thing that has contributed to [the ENTHUSE Partnership] doing well is the fact that I've kept on recommending that they use some of the key internet facilities and resources. The TAPS assessment materials from the Primary Science Teaching Trust, Explorify, the STEM Learning activities themselves, are key.
>
> **Adviser**

A clear vision

Advisers describe how important it is for partnerships to establish clear objectives across the partnership before embarking on CPD and developing enrichment activities for pupils to ensure the desired outcomes can be achieved. Senior leaders and Advisers describe how school-level objectives for the partnership are often tied to wider geographic or structural challenges, for example, digital poverty, low levels of STEM employment, parental unemployment or the under-representation of women in STEM careers. It is important that these factors are considered when agreeing key priorities. Some Advisers also convey the importance of providing schools with the flexibility to tailor their enrichment activities to meet the schools' priorities.

The case study partnerships highlight common objectives that are agreed in consultation with their Advisers. Example objectives include wanting to reach a wider cohort of pupils who have STEM career aspirations, improving teachers' subject knowledge and confidence to teach STEM and supporting pupils to work more scientifically through practical investigations:

> Our objective was about getting the children to be working more scientifically, thinking like a scientist and hitting those working scientifically objectives. We were good at imparting the knowledge, but [not] performing experiments and predicting results.
>
> **Science leader**

An experienced Adviser

STEM Learning stakeholders note that established Advisers, that is, those with experience of working with STEM Learning and who have strong links to STEM organisations and industry, are vital to the success of partnerships. Regular Adviser-led meetings help bring schools together and promote collaboration, as well helping to manage schools' competing priorities. Leaders and teachers within the partnerships agree that the Adviser also acts as a facilitator to help them identify and shape their ideas and solutions to meet their objectives. The benefits that Advisers offer partnerships include:

– Guiding partnerships through the ENTHUSE application process.

– Sharing information about ENTHUSE and parallel funding opportunities.

– Identifying the requirements and associated objectives for the partnership.
– Supporting the partnerships with reporting requirements.
– Encouraging and facilitating collaboration between partnership schools.
– Sourcing and signposting schools to employer contacts.
– Mentoring science leaders.
– Designing, arranging and delivering CPD through local networks and partner schools.

> Our Adviser has been inspirational to all the teachers. He's come in with lots of good ideas, but he hasn't been overbearing. He's also allowed us to steer the partnership in the direction we want to go.
>
> **Science teacher**

> I like to think that I've kept them all going together. Through me being there means they kept having these meetings, and they've continued to build and grow in confidence. And I think the tone of the meetings is good because I lead it that way. Encouraging people to share ideas with each other and taking an interest and going to different schools, I think is a key thing.
>
> **Adviser**

Strong leadership

Interviewees highlight the importance of schools securing senior leadership buy-in to the success of ENTHUSE Partnerships. When school leaders establish a culture of innovation and prioritise the partnership activities across the whole school, they protect teachers' time for training and encourage knowledge transfer and collaboration between schools. This optimises the opportunities for success. In instances where school leaders have been unable to fully commit to the partnership, because of competing priorities, a lack of geographical proximity or other internal challenges, they are unable to maximise the partnerships' full potential. Advisers report that these schools frequently end up withdrawing or disengaging from the partnership.

> What we wanted to do very early on was give that commitment to the ENTHUSE Partnership and be able to say, right, OK, regardless of the pressures that it puts on [the school], we should prioritise and because we prioritised, I feel that we've probably got a little bit more out of it.
>
> **Science leader**

Tailored staff CPD

Practical CPD for staff in partnerships is a key enabler of success for partnerships. Teachers and leaders interviewed identify several advantages of engaging in CPD including greater confidence, improved scientific knowledge, the ability to run more

scientific investigations, increased knowledge and understanding of STEM careers and an increased enthusiasm and motivation towards STEM subjects. Advisers help staff to identify the CPD that will best meet the partnership's objectives. For example, one teacher attended STEM Learning training to gain specific knowledge and skills to lead on physics in their school. As a result of the CPD, they report becoming a more confident teacher in the classroom and leading a STEM club in the school. Other science leaders engaged in training to enable them to implement STEM clubs in their setting that they then cascaded to other teachers in the partnership to expand the provision. This approach also saved time and money, enabling partnership funds to be used to equip STEM clubs with more resources.

> Some of the best practice ENTHUSE Partnerships have a meeting of the Leaders within each other schools, with the Adviser. The person who's been on some CPD feeds back and disseminates their learning at the meetings. They're able to train others, following that CPD.
>
> **Science leader**

The documentation review suggests that some partnerships delivered fewer activities than others. Advisers interviewed describe how this reflects the capacity of school leaders to commit to the partnership when there are other competing priorities, such as delivering against improvement plans, Ofsted inspections, recruitment and retention challenges and responding to the COVID-19 pandemic. A small number of Advisers and STEM Learning stakeholders express the view that due to squeezed school budgets; some schools are motivated purely by access to free CPD and are less inclined to develop further on their own initiative:

> The post-COVID teacher recruitment and retention crisis is linked to a massive capacity issue within schools. That is the biggest challenge that we're now facing. Schools just don't have the means, either the funding to release teachers or the bodies in the classrooms to get them.
>
> **STEM Learning stakeholder**

> The benefits of being in an ENTHUSE Partnership might not be seen as worth it. It's just too much work to get it back up and running. It's nice to have. They'll still be in front of their classes, students will still get taught, and the school will still operate if they're not part of an ENTHUSE Partnership.
>
> **STEM Learning stakeholder**

Some schools struggle to find time for all the planned activities and collaboration due to busy schedules, difficulties securing replacement teachers and partner schools being spread over wide geographical areas.

> I think the biggest challenge, as usual in education, is time. It's getting people together for these meetings because schools have their peaks and troughs of busy times, like Christmas time. It was quite hard to get everybody together then.
>
> **Science leader**

These barriers contribute to difficulties in creating momentum following CPD training and sustaining the partnerships and associated activities beyond the funding period. When administrative and reporting requirements are finished, schools perceivably have less motivation to sustain the partnership and its activities.

Enrichment opportunities for pupils

The funding provided as part of ENTHUSE Partnerships enables schools to develop a range of tailored enrichment opportunities for both primary and secondary school pupils that are essential to successfully meeting their objectives. Partnerships have offered pupils a diverse programme of activities, including:

- **Science weeks and science fairs** designed to provide engaging activities for pupils and parents to celebrate pupils' work.
- **Practical experiences and excursions** including visits to industry and places of scientific interest.
- **STEM club projects** that aim to spark pupils' interest towards STEM subjects and support them to extend their STEM knowledge through extra practical investigations and projects.
- **Employer visits and projects** that help to raise pupils' awareness of STEM and improve their knowledge about STEM careers and pathways into them.

Teachers report enrichment activities support pupils to see the relevance of STEM in their everyday lives and that a STEM career could be for someone like them:

> In some areas, we're working with schools where there's multi-generational worklessness and the teachers are desperate to get someone in to speak to the kids. Employers will come in and have that real influence because the kids can suddenly see, 'That's someone like me. They grew up in the same area as me. They're doing this'.
>
> **STEM Learning stakeholder**

Links to employers

Establishing strong links with industry and employers is an important enabler of success for partnerships but is challenging for some schools to achieve. The case study ENTHUSE Partnerships successfully established their own links with employers independently and developed relationships to facilitate in-school and external visits that have enhanced the schools' STEM curriculum and increased pupils' interest in STEM subjects and future careers. Partnerships efforts to expand

their employer network, though, have not always been successful and in some instances could have benefitted from mediation with an Adviser and the support and involvement of STEM Ambassadors:

> We set up the Rocket Day, the Civil Engineering Challenge Day and we had BAE Systems saying they would come out to schools, but it just never came about. It just was quite frustrating when you gave them a month's notice.
>
> **School leader**

STEM Learning stakeholders highlight that matching funders' expectations with schools' objectives and priorities can be a challenge. It takes time to explore funders' requirements and, if too specific, it can be difficult to find local schools to partner with. Supporting employers to understand the learning and teaching challenges that schools face and exploring how employers can support specific projects to address these has been suggested as a more beneficial way to secure funding and in-kind support from employers.

> I think we're always starting from scratch. I think that's inevitable because schools will not always be ready. By the time a funder in a location is ready, there might not be the schools available. So, it's trying to keep on top of that information.
>
> **STEM Learning stakeholder**

Reporting, monitoring and evaluation

Streamlined monitoring and evaluation processes enable partnerships to effectively demonstrate the impacts achieved by their partnerships. Some schools interviewed view the termly reporting requirements as an administrative burden and the documentation review on a selection of these reports shows that there are gaps in the data and a lack of details about outcomes and impacts achieved.

STEM Learning's in-house surveys for teachers and pupils achieve high response rates at the start of the partnerships, but responses tailor off for the mid-point survey and again at the end of the partnership, which means the data becomes patchy and less representative. The historic use of paper surveys for collecting pupil data relies on schools to aggregate and return this data, which has been burdensome for schools. Some interviewees have also questioned the value of the pupil surveys, as the extent of pupil engagement in both partnership activities and wider activities is unknown, which makes it difficult to attribute changes in pupils' perception to the partnership. STEM Learning stakeholders highlight competing requirements for schools to fulfil monitoring and evaluation reports from STEM Learning and those from funders. Currently, there is no unified approach in reporting to different funders and this element of the programme often requires considerable time and is subject to continuous changes.

Conclusions

The ENTHUSE Partnerships programme, funded by STEM Learning continues to support primary and secondary schools to enhance their STEM curriculum, provide enrichment activities for pupils, and strengthen links between schools and local industry. A range of teacher-, pupil- and school-level impacts have been achieved, some of which will be sustainable beyond the funding period through the provision of high-quality CPD for teachers, school leaders and technicians, access to training resources, guidance from a dedicated Adviser and access to the STEM Ambassadors initiative.

Teacher impacts

Participation in ENTHUSE Partnerships via access to high-quality CPD has enabled a range of teacher impacts to be achieved, irrespective of their STEM discipline and school phase. This includes improved teaching practice and pedagogy, enhanced subject knowledge and lesson planning and assessment and increased confidence. Secondary school teachers found they also have an enhanced understanding of STEM careers and study pathways. Reigniting teachers' enthusiasm and passion for STEM is a further key outcome achieved via the programme. Participation in an ENTHUSE Partnership has been particularly beneficial for primary school staff, who at the outset of the partnership had lower levels of confidence in using practical activities to teach STEM subjects and lead enrichment opportunities. After being in the partnership, there are large uplifts in the confidence of primary school teachers. Similarly, there are larger increases among primary school teachers than secondary teachers regarding the programme effectively supporting their understanding of the curriculum for their subject to support lesson planning. CPD and enrichment activities with employers via ENTHUSE Partnerships have successfully enhanced teachers' knowledge about STEM careers and pathways, enabling them to integrate content into their lessons and provide accurate signposting and advice to pupils.

Pupil impacts

Enhancing schools' STEM curriculum and the introduction of sustainable enrichment activities via ENTHUSE Partnerships positively impacts pupils by increasing their enthusiasm and enjoyment towards STEM subjects, improves their ability to make links between science and the everyday world, increases their self-belief that they can do well in STEM subjects and enhances their knowledge about STEM careers and further study pathways. More sizeable impacts have been achieved for primary school pupils than for secondary pupils across all areas. The exact reasons for these differences are unknown. Differences in how primary and secondary partnerships mobilise and integrate resources and the extent of employer collaboration could account for the differences, while differences in the sample characteristics of secondary school pupils over time could be a further explanation.

School and ENTHUSE Partnership impacts

STEM Learning's success criteria for partnership schools have been largely met. Most partnerships have taken full advantage of the STEM Learning CPD offer and other training resources available to them, which has enabled them to increase the profile of STEM subjects in their setting. Increased collaborative working during the partnership has led to increased sharing of good practice and resources. Collaboration across partner schools with employers and parents has also enabled schools to deliver a range of innovative enrichment activities. Employer links have been successfully established in some cases, but initiating these has been challenging for some schools. School leadership across a range of areas had improved over the course of the partnerships, an area in which primary schools were less secure than secondary schools at the outset of the partnerships. Improved outcomes for pupils are also reported, although in the absence of pupil attainment data and information about GCSE and 'A' Level subject choices, the evidence is less concrete.

Success factors contributing to sustainable partnerships

ENTHUSE Partnership funding ensures partnerships can achieve a wide range of sustainable benefits and in the absence of dedicated funding many of the outcomes and impacts achieved would not have been possible. However, funding alone does not lead to success – support from experienced Advisers is crucial to help foster links with partner schools and employers and to signpost to relevant CPD opportunities. Advisers also play a key role in helping partnerships to develop a clear vision for their partnership and to evidence progress towards meeting partnership objectives. Where schools have established links with employers, they have benefitted from funding but also other in-kind contributions. Sustaining these links, though, will be a challenge for most partnerships once funding ceases.

Considerations

To inform the future of the ENTHUSE Partnerships, STEM Learning may wish to consider the following areas:

– **Support partnerships to thrive throughout and beyond the funding period** by considering the most effective ways for partnerships to remain *fully active*. This includes developing a more detailed understanding of how schools can be most effectively supported to achieve their partnership's objectives by implementing learning from CPD, together with a full programme of activities within their setting and fostering and maintaining links with employers. The Adviser role is critical to the success of ENTHUSE Partnerships and they should continue to support partnerships, especially those at risk of withdrawing or becoming inactive and help them to become sustainable.

– **Encourage partnerships to establish stronger links with both primary and secondary schools.** Overall, ENTHUSE Partnerships are most impactful for primary school pupils rather than secondary pupils. It is essential that the outcomes achieved for primary pupils are not lost when they transition to

secondary school. There is an opportunity for partnerships to focus more fully on the transition stage between primary and secondary school by ensuring one or more secondary schools participate in the partnership. Developing a fuller understanding of why secondary school pupils' perceptions towards STEM subjects and careers become less positive over time is important to help partnerships develop activities to address declines.

- **Implement more robust and streamlined approaches to monitoring and evaluation** to enable the outcomes and impacts of the programme to be more accurately captured and attributed to the partnership and to reduce the burden on teachers and pupils. Reducing the survey sampling points to an online pre-post design at the start and end of the partnerships administered by an external agency would improve the data collection methods. Consideration should be given to replacing termly reports with a live, consolidated reporting document stratified by theme (e.g. classroom activities, enrichment activities, employer engagement) and with predefined drop-down menus. To capture more accurate pupil data, consideration should be given to implementing innovative data collection activities, in situ when activities are being hosted to collect immediate feedback (e.g. through an app or photo capture method, pupil focus groups and short interviews).
- **Review marketing and branding methods** and use evaluation findings and case studies to raise awareness of the ENTHUSE brand and the impacts achieved for schools and employers. Developing tailored materials for employers that showcase the specific outcomes for them and the range of ways in which they could support schools could help to increase employer engagement in the programme. STEM Learning could implement new ways of marketing the ENTHUSE Partnerships to both schools and employers, focusing on encouraging employers to support the aims of responding to teaching and learning challenges in schools, rather than requiring an exact match of priorities.

Appendix 1: Case studies

President Kennedy ENTHUSE Partnership

Developing curiosity and engagement in STEM

About the President Kennedy ENTHUSE Partnership

Established in 2021, the President Kennedy ENTHUSE Partnership is part of The Futures Trust located in the West Midlands. The partnership comprises four primary and four secondary schools from the Trust. The percentage of pupils eligible for free school meals ranges from 19% to 42%.

The partnership aims to spark curiosity and greater engagement in STEM subjects with a view to improving attainment, increasing the uptake of STEM subjects at post-16 and developing teacher and pupil knowledge of entry routes into STEM careers.

> "STEM has become a huge part of our school improvement plan over the last few years and raising the engagement of students in STEM has been a real driver. We were very keen on the networking, the CPD opportunities and the collaboration it has facilitated." (Senior Leader)

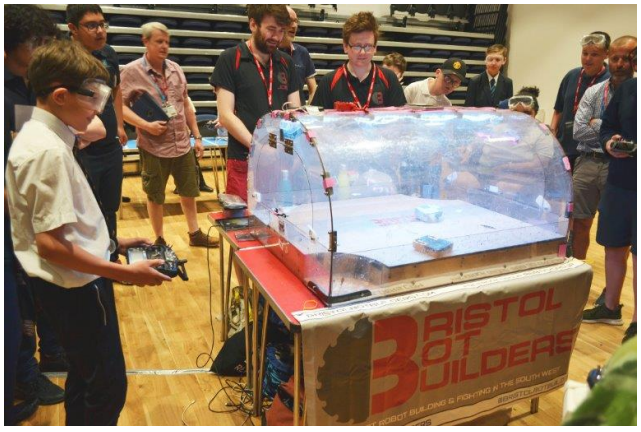
ENTHUSE Partnership activities

CPD delivered by STEM Learning for subject leaders, teachers and technicians focused on how to teach science subjects effectively, use software packages and set up and run STEM clubs.

> "We've been able to request the CPD that we need. And we have had staff CPD …. we have had science technicians come together in our school for microscale chemistry training, funded through STEM Learning." (Science Leader)

Through an existing relationship with the school, a representative from Arup Engineering, a worldwide multidisciplinary design and engineering consultancy, volunteered to develop a bespoke enrichment activity for the STEM clubs, launching the 'Robot Wars' programme. Students of all ages and abilities designed and built their own robots before showcasing them at a partnership-wide Robot Wars competition.

> *There is a whole mixture of needs and abilities [in the school] and finding something that worked across all of those was quite tricky. If you have an 18-year-old 'A' level [student] versus a 7 to 8-year-old primary school [pupil], [the Robot Wars competition] is down to how well they can drive the robot, there is no academic bias and it levels it massively. (Arup Engineering)*



Impacts of ENTHUSE Partnership activities

Pupil impacts

More pupils opting for science at GCSE and 'A' Level: More pupils across the partnership engage in STEM enrichment activities and are selecting to study Triple Science at GCSE and 'A' level sciences in greater numbers.

> *"We're seeing student option choices lean more towards STEM subjects post-sixteen. The number of students who are picking Triple Science, rather than just doing combined science, is increasing. As a result, the careers they go into post-eighteen will change." (Senior Leader)*

Wider participation in STEM enrichment: As a result of STEM clubs being introduced in all partnership schools, pupil participation in enrichment opportunities has increased. This has also increased opportunities for a greater diversity of pupils to participate in STEM clubs.

> **"The students that I've had come through my STEM clubs have been from a wide range of backgrounds and have generally had additional needs or have been Pupil Premium."** (Science Leader)

Increased knowledge about STEM careers*:* Pupils' awareness and knowledge about different STEM careers and the pathways into jobs has increased and more pupils aspire to a future STEM-related career.

> **"More students are saying that they have an awareness of different STEM careers available to them, especially within the local area, so I think it's definitely broadened their horizons."** (Science Leader)

Teacher impacts

Increased awareness of STEM Learning programmes and resources, which led to an uptake in CPD: Teachers' motivations for attending CPD include improving teaching practice, STEM subject knowledge and subject leadership.

> **"Just the awareness of STEM Learning is massive now as well because [staff] will say to me, 'I've never taught this topic in chemistry before'. And it is like, 'Well, look on the STEM Learning website and see the CPD that's coming up'."** (Science Leader)

Improved STEM subject and enrichment content and delivery: High-quality STEM CPD has improved the content of science lessons and STEM enrichment activities because teachers feel more inspired and confident about STEM.

What next for the partnership?

The STEM club programme for all partnership schools continues beyond the ENTHUSE funding period (March 2021–July 2023). More schools are participating in the club, including schools in other ENTHUSE Partnerships, across the West Midlands region. The experience of running Robot Wars and the spotlight on STEM careers in the region has given schools a platform to approach more employers, such as Caterpillar, for further funding. Partnership schools have also received funding to purchase additional 3D and science lab equipment. Building on the partnership, The Futures Trust has developed a new STEM CPD programme, which to date has been cascaded to over 50 teachers in 20 schools.

Greenbank ENTHUSE Partnership

Sparking girls' interest in STEM careers through enrichment activities

About the Greenbank ENTHUSE Partnership

The Greenbank partnership was established in 2022 and comprises six secondary schools located in Merseyside. The percentage of children eligible for free school meals is comparable to the national average in four of the schools, and below average in the other two. Keen to focus on the under-representation of women in the STEM workforce, the partnership aims to raise girls' awareness of and interest in STEM careers through a programme of enrichment activities that connect girls to STEM employers in the North-West.

ENTHUSE partnership activities

New STEM enrichment clubs in all the partnership schools have created opportunities for girls to take part in research and development projects linked to STEM employers, for example, the Unilever Bright Future Inspire project. Girls have also participated in Rocket Clubs, where they used computers to assist in the design and build of ignition-fuelled rockets. STEM enrichment clubs showcase careers in aeronautical engineering with testimonies from female rocket designers.

Subject-specific CPD has supported STEM teachers and technicians in the practical delivery of GCSE science subjects and the cascading of knowledge to teachers who deliver combined science.

Impacts of ENTHUSE partnership activities

Pupil impacts: Greater awareness of STEM careers

Girls are inspired by learning about the wide range of roles available at companies such as Unilever, entry routes into the company and hearing personal testimonies from female employees.

> *"Girls are realising that science and STEM careers could be for them and some of them have been like, 'I never thought I'd want to do this, but actually it's quite good.' It was eye opening." (Science Leader)*

Increased confidence in STEM tasks: Previously described as 'traditionally male' (e.g. constructing circuit boards), STEM Clubs have improved student and staff relationships, leading to better engagement in science lessons and more girls selecting Triple science at GCSE level.

"The [Unilever project] definitely made a big impact on those students, they're still coming to me and asking about doing more stuff and continuing with the STEM club, and you know, I'm seeing some of them wanting to do separate sciences [at GCSE]. It's had an impact on their enthusiasm towards science. It has a legacy with other children, who say 'I'd quite like to do that.'" (Science Leader)

Teacher impacts

Improved STEM practical knowledge: Because of the subject-specific training teachers are more inspired to update the STEM curriculum across the partnership and have gained skills to embed practical and investigative activities into lessons.

> *"Through CPD, teachers have managed to improve their subject knowledge and confidence to talk to students about careers in STEM and encourage them to follow such career pathways." (Adviser)*

Supported career progression: Senior leaders gained the confidence to apply for and to fulfil senior positions in STEM subjects that have been difficult to recruit, easing recruitment and retention challenges.

"I think my confidence to apply for the physics job was because I was lucky enough to have a physics teacher in the training at Edge Hill. Without that, I wouldn't have felt confident enough to maybe apply for the physics job." (Science Teacher)

An established technician's network across the partnership: It has increased knowledge transfer, enabled more resources to be shared and continued the commitment to using practical approaches in science lessons.

What next for the partnership?

STEM clubs and competitions have continued beyond the partnership funding – the equipment can be re-used, and the practical knowledge and skills will continue to cascade across schools. Activities that support entry into STEM careers will continue, including competitions with employers and careers advice to support girls to choose STEM subjects at GCSE and beyond.

"The relationships and the connections that have been built through the partnership will enable people to continue the clubs...the culture has shifted to a more collaborative way of doing things." (Senior Leader)

Pokesdown ENTHUSE Partnership

Practical science opportunities to improve working scientifically

About the Pokesdown ENTHUSE Partnership

The Pokesdown ENTHUSE Partnership was established in April 2023 and comprises nine primary schools located in socio-economically diverse areas in Bournemouth and Christchurch. The schools vary in size from 215 to 838 pupils and the percentage eligible for free school meals ranges from 4% to 48%.

Focused on enhancing 'working scientifically' skills, particularly for pupils with special educational needs or disabilities (SEND) through practical investigations and enrichment activities, Pokesdown ENTHUSE Partnership aims to increase staff confidence to teach science and further develop science assessment procedures.

> **"Our objective is to get children to work more scientifically, thinking like a scientist and hitting those working scientifically objectives."** (Science Leader)

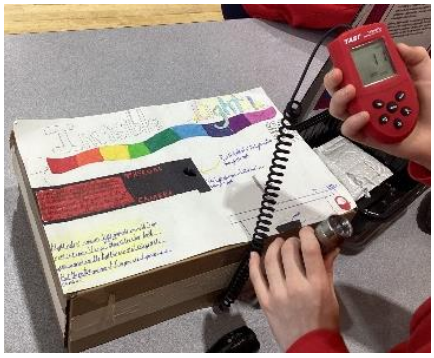
ENTHUSE Partnership activities

Teachers and support staff have participated in a suite of CPD activities tailored to their school context.

> **"At the Pokesdown partnership, there's been a big focus on outdoor science, to get pupils outside, more hands-on."** (Science Leader)

Using their ENTHUSE funding, the Pokesdown partnership has delivered a range of activities for pupils including:

- A science week and science fairs involving children and their families via home projects
- 'Meet the scientist' events with a STEM Ambassador
- Visits to a planetarium, organised in conjunction with Science Zone UK
- Activities using the 'Borrow the Moon' kit, supplied by the Science and Technologies Facilities Council
- Peer-to-peer learning, where older pupils became Junior STEM Ambassadors and used Explorify activities to mentor younger children in their school



"Older children are taking lead roles as Junior STEM Ambassadors. They have devised quizzes for the Key Stage 1 children using the Explorify materials. I think that's genius." (Adviser)

Further initiatives include a gardening project, the establishment of a bird hide, and the creation of a science lab.

> "We've now got a dedicated science lab - it's not like a secondary school science lab, but it's set up with all the resources." (Science Leader)

Impacts of ENTHUSE Partnership activities

School impacts

Increased profile of science: Science now shares the same high profile as maths and English within schools.

> **"Science is getting a bigger profile within the partnership; it's getting a bigger slice of teachers' time. And there is more commitment to science."** (Adviser)

A notable **increase in the number of practical, interactive, indoor and outdoor science** activities for all year groups: for example, science weeks, science fairs, STEM Ambassador visits and gardening projects.

> **"I think the science fair has been the most impactful because it built on children's new enthusiasm."** (Science Leader)

Increased collaboration and shared learning: Strengthened connections have fostered collaboration between schools resulting in enhanced science provision within individual schools.

> **"I think the communication between different schools has been great, which they've used as an opportunity to share ideas and best practice."** (Teacher)

Impacts on teachers

Enhanced science knowledge: Teachers are drawing on their new knowledge and shared learning to adapt activities for different year groups.

> **"You can do science with PE, science with maths, science with English, science with geography, science with art. You know, all those things are possible if the way you organise your teaching isn't too rigid."** (Adviser)

Increased confidence to teach and assess science: CPD opportunities have reinvigorated teachers' passion for science, opened conversations and encouraged them to ask questions without feeling judged.

> **"We've got the buzz about science back."** (Science Leader)

Teachers' greater confidence has led to an increase in the volume of science taught, particularly through practical and exploratory lessons.

> **"The CPD has given teachers the confidence to let go a bit in science lessons, and work more scientifically, and be a bit more open-ended, be a bit more child led."** (Assistant Headteacher)

Impacts on pupils

Improved engagement in science lessons: Delivering science in a more practical and immersive way has increased pupil engagement in science lessons and participation in extracurricular clubs. Children with SEND are more engaged during practical lessons and are better able to manage their behaviour.

Improved reading, writing and oracy skills: Those who have previously found reading and writing tasks challenging are progressing in their learning at the same pace as other children, and children are encouraged to ask questions and engage in discussion using their scientific vocabulary.

“At the outdoor lessons, children don't feel threatened when you're asking them questions because they're working side-by-side with you, it's not so daunting as sat in the classroom situation.” (Science Leader)

What next for the partnership?

The Pokesdown Partnership will continue until December 2024 with further CPD scheduled. The schools plan to further incorporate ‘working scientifically’ skills into their science curriculum. The partnership will be sustained beyond the funding period, continuing to enrich the learning environment for practical science education.