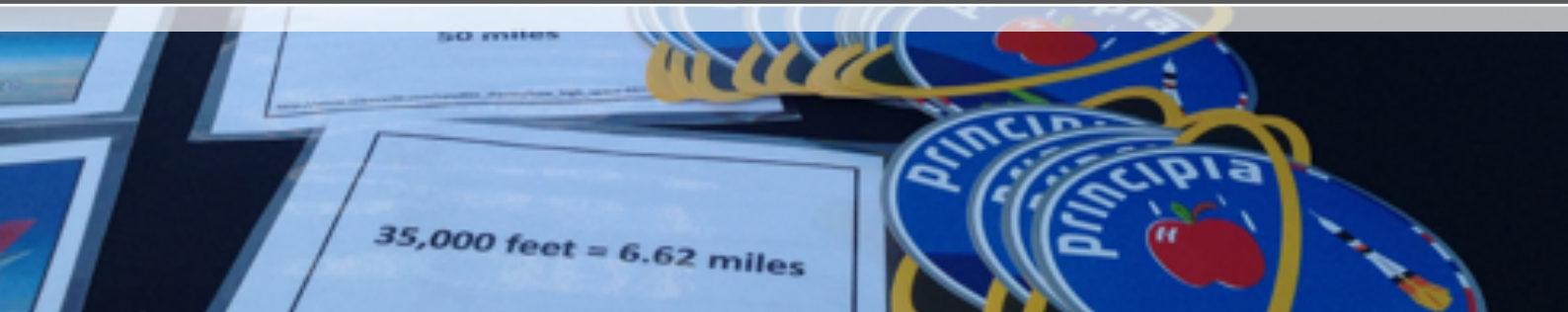


**Manchester
Metropolitan**
University



External Evaluation
of the Tim Peake Primary Project



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► Space Ambassador Amanda Poole with finalists from across Coventry and Warwickshire at the Principia Science Fair at Warwick University.

“Thank you very much indeed for allowing me to take part in the project, and the resources are so invaluable. I’ll use them for years to come, that’s for sure, and continue to share them in school as well.”

(Teacher)

This report details the external evaluation of ESERO-UK’s Tim Peake Primary Project (TPPP), which ran in 1,400 UK primary schools from 2015-2017, and used Tim Peake’s mission to the International Space Station (ISS) to promote space as a cross-curricular context for teaching science, literacy and numeracy. Delivered by the European Space Education Resource Office in the UK (ESERO-UK), and funded by the UK Space Agency and the Department for Education, with further support from the European Space Agency, the project delivered continuing professional development (CPD), resources and support from specially trained Space Ambassadors (SA) to teachers. The TPPP aimed to increase teachers’ confidence in teaching space-related topics, and consequently their engagement with enquiry-based teaching and learning in science, in order to increase pupils’:

- Enjoyment and engagement in science, numeracy and literacy
- Confidence in learning science and working scientifically
- Knowledge of career opportunities available to them if they study mathematics and science
- Attainment in science

The external evaluation was conducted by researchers at the Education and Social Research Institute, Manchester Metropolitan University.

1.1 Methodology

The evaluation used STEM Learning’s Model of Change¹ as a framework for the analysis of qualitative and quantitative data, generated using surveys, telephone interviews, and face-to-face interviews with Space Ambassadors and teachers who had participated in the project, to:

- Assess the longer-term impact of schools’ engagement in the programme on teachers, pupils and schools.
- Assess the efficiency of the project delivery model and provide recommendations on how to improve management, delivery and impact of the programme, especially if adopted for other similar projects or programmes.

1.2 Key findings

The findings of this external evaluation confirm the initial findings of an interim evaluation conducted by STEM Learning that the project and using space as a context for teaching and learning directly increased pupils’ enjoyment and engagement in science, numeracy and literacy; increased pupil attainment in science; and increased teachers’ confidence in teaching space-related topics and using space as a cross-curricular context for teaching. More specifically:

1. Survey and interview data found that pupils’ enjoyment and engagement in science, numeracy and literacy increased and this has been sustained in schools that continue to use the TPPP or apply lessons learned through their participation in the project.
2. Pupils’ attainment in science increased, which has been sustained to some extent.
3. The TPPP has had a positive impact on teachers’ confidence in teaching space topics (81% of survey respondents) and using space as a cross-curricular context for teaching and learning (60%).
4. The TPPP was beneficial for engaging groups of young people who would otherwise not usually engage: e.g. girls or young people who were usually passive or had specific learning needs that made participation difficult.

5. Longer-term impact on teachers and schools is evident in the continued use of resources provided in the starter kit and teachers' increased confidence in developing their own resources for use in teaching with or about space.
6. Using space as a cross-curricular context for teaching had a larger, and in some cases more sustained, impact on educators and schools.
7. Participating in the TPPP led to an increased awareness of further STEM subject study and impacted on future career aspirations.
8. The reach of the TPPP extends to parents, grandparents and members of the local community who directly and indirectly engaged in the TPPP.
9. Networking between schools has increased, providing opportunities for sharing good practice in the delivery of STEM education and the organisation of joined up events – reaching young people and schools who did not directly participate in the TPPP.
10. There is emerging evidence that being involved in the TPPP contributes towards teacher career progression.
11. Involvement in the TPPP has been instrumental in helping some schools meet external pressures, such as performing for OFSTED inspections or meeting the standards described by the Donaldson report. The management of the TPPP project was found to be very effective.
12. The resources provided were identified as the most important element of the project (93% of teachers responding), followed by the support provided by Space Ambassadors (76%).
13. Space Ambassadors were a crucial aspect of the TPPP: they were important sources of information related to teaching science and space, and a local point of contact who could encourage involvement in, or visits to, local STEM initiatives, and a critical friend who was instrumental in increasing teacher confidence and subject knowledge in space topics.

14. CPD provided by Space Ambassadors was rated as crucial or very important by 73% of respondents. The resulting projects usually had a greater impact on the engagement of teachers when this CPD was provided to over half of the teachers in a school.

15. When the CPD was provided to at least half of the teachers in a school, it was more likely to result in programmes of activities that involved the whole school, which had greater longer-term impact on pupil and teacher outcomes.

16. CPD provided to teachers from multiple schools attending a shared session could encourage active networking between local schools participating in the TPPP.

17. Improvements to the management of the project, suggested by teachers, most often concerned increasing the amount of time that schools had with their space ambassadors.

1.3 Recommendations

“Only negative to the project was wanting to do a lot more and not having the time to do it.”

(Teacher)

Given the findings outlined above, and in particular that the TPPP was beneficial for increasing teachers' confidence for delivering STEM activities and engaging young people's interest in STEM learning activities, the following recommendations apply for the roll out of future projects.

1. The TPPP provided an effective management model that should be replicated for use in other, particularly STEM-related, education programmes.

2. Future projects should use the TPPP resources as a model of excellence (given the positive feedback received) but also take account of the specific pointers below on how resource provision could be improved further.

- 3.** An index sheet should be provided that links the resources to the different areas of the curriculum, and potentially how they feed into the various primary curriculum teaching packages available.
 - 4.** Roll out the TPPP again in future, particularly if Tim Peake returns to the ISS.
 - 5.** Cross-curricular context-based teaching could be applied effectively across other key stages, at secondary level, to provide a real-world context for the skills and knowledge taught.
 - 6.** Identify opportunities to build on key science events to maximise opportunities for enhancing engagement with future projects, particularly those related to space and those involving role models that young people in the UK can identify with.
 - 7.** Establish the means for rural schools, or those in urban areas with fewer university or industrial links, to access other resources and events to enrich their engagement in similar projects or delivery of STEM subjects.
 - 8.** Engaging head teachers should be considered as a first step to engaging with schools.
 - 9.** First contact with schools, made by SAs after their initial registration, should be as early as possible to provide enough time to plan and prepare for the delivery of the project.
 - 10.** Encouraging schools to develop an embedded cross-curriculum approach to the delivery of the TPPP, and future projects, providing guidance on how the resources fit into different areas of the primary school curriculum. In particular, such guidance should highlight and prioritise the role of TPPP activities in meeting literacy and numeracy targets.
 - 11.** Future projects should also encourage the use of a cross-curricular approach through the organisation of a regular whole school day/week, to raise the profile of science in schools and establish larger, more sustained impact.
 - 12.** Providing goals for schools at the outset, such as achieving the Space Education Quality Mark, could provide incentives for engaging with the project and sharing their learning.
 - 13.** The CPD provided in future projects should include a focus on measuring the impact on attainment, as an understanding of this impact would be useful evidence to inform teachers' pedagogical approaches as well as informing future project delivery.
 - 14.** Provide online CPD provision that extends the CPD provided by SAs – providing options to catch up with recordings of webinars and options to work offline in areas with limited connectivity.
 - 15.** Making schools aware of the role of the TPPP and similar projects in addressing the gender gap in STEM qualification take-up and STEM careers and continuing interests in inclusive education. Additional guidance and exemplars of good practice for teachers would be beneficial.
 - 16.** Provide more 'take home' resources for pupils (with links to online resources) and extra-curricular opportunities for young people and parents to engage with the project.
 - 17.** Primary schools should be encouraged to continually provide young people with experiences such as the TPPP that raise awareness of the importance of science and STEM career possibilities, and that this awareness is sustained.
- "The biggest benefit of the project has been 'increasing people's knowledge definitely, and putting science back into people's minds, doing lots of it really.'"
(Teacher)

The Tim Peake Primary Project (TPPP), delivered by the European Space Education Resource Office in the UK (ESERO-UK) and funded by the UK Space Agency (UKSA) and the Department for Education (DfE) with further support from the European Space Agency (ESA), provided support for 1,400 primary schools to use space as a context for teaching. British astronaut Tim Peake's Principia mission to the International Space Station (ISS) in December 2015 provided an opportunity to situate space, and consequently STEM (Science, including computing; Technology; Engineering; and Maths), education within an authentic setting - accessible through anticipated media coverage of the experiences of the first British astronaut on the ISS.

The TPPP offered schools the support of specially trained Space Ambassadors (SA) - to provide Continuing Professional Development (CPD) and facilitate space-related activities in schools - and a starter kit of resources tailored towards the primary school curriculum. Two cohorts of primary schools, 2015/16 and 2016/17, took part in the TPPP, which aimed to:

- increase pupils' enjoyment and engagement in science, numeracy and literacy;
- increase pupils' confidence in learning science and working scientifically;
- increase pupils' knowledge of career opportunities available to them if they study science and mathematics subjects;
- increase pupils' attainment in science; and
- increase teacher confidence in teaching space topics.

ESERO-UK, also known as the UK Space Education and Resource Office, aims to help teachers use the context of space to open doors for young people by delivering engaging, world-class teaching in STEM. ESERO-UK is based in the National STEM Learning Centre in York. Working alongside STEM Learning Ltd, ESERO-UK is able to provide influence, funding and services to improve the teaching of STEM subjects in schools and colleges, and inspire young people through engagement and enrichment activities.

In an internal, interim evaluation², teachers stated that the project directly:

- increased pupils' enjoyment and engagement in science, numeracy and literacy;
- increased pupil attainment in science;
- increased their confidence of teaching space-related topics; and
- increased their confidence of using space as a cross-curricular context for teaching.

This evaluation also indicated that the project:

- raised the profile of STEM subjects in schools; and
- developed the capacity of educational and space experts to take on the role of SA.

This report details the findings of an external evaluation of the TPPP, conducted by researchers at the Education and Social Research Institute, Manchester Metropolitan University. It aims to assess the extent to which the impact of the project (detailed in the interim evaluation) has been sustained in the longer-term - in the academic year(s) following each school's engagement in the project. It also explores the efficiency of the project delivery model in order to develop recommendations for the management, delivery, and impact of future projects.

2.1 Background research

The importance of effective (STEM) education at primary school level in promoting the later uptake of STEM subjects leading to careers in STEM is widely recognised³. In addition, there is a strong correlation between the provision of CPD for teachers delivering science and the overall effectiveness of science education⁴.

There is considerable evidence that those teachers who access sustained subject-specific professional development: improve in their subject and pedagogical knowledge, skills and confidence; improve and enrich teaching and learning; and support young people's engagement, progression and awareness of careers in STEM-related fields³.

High-quality teaching is therefore instrumental in positively affecting students' attitudes and motivation for STEM. In practice, student learning is most effective when facilitated within authentic settings that promote enquiry-based practices: valuing active meaningful learning, reasoning and problem-solving, and the development of creativity⁵. Such contextual learning has been described as critical to the learning process, where scientific knowledge is better understood when applied to actual STEM practice⁶.

The evaluation assessed the impact of the TPPP with regards to STEM Learning's Model of Change (MoC), shown in Figure 1. Schools were provided with a box of resources, the TPPP Starter Kit, together with CPD and support from a SA local to their area of the country. The MoC describes how engagement with these three key elements aimed to have a positive impact on teachers' development and pupil outcomes. Therefore, the questions asked during the evaluation focused on the outcomes described by the MoC to address two key objectives:

- Assess the longer-term impact of schools' engagement in the programme on teachers, pupils and schools, particularly to what extent the short-term impact (as presented in the interim evaluation) has been sustained.
- Assess the efficiency of the project delivery model and provide recommendations on how to improve management, delivery and impact of the programme, especially if adopted for other similar projects or programmes.

The evaluation combined quantitative and qualitative methods of data generation during three key phases. Phase 1 involved a document analysis of the interim evaluation report, conducted by STEM Learning, and the analysis of data generated by a follow-up survey of longer-term impact and sustainability (which will be referred to as the Y1 follow-up survey), also conducted by STEM Learning. The survey was distributed to schools who participated during the first year of the TPPP. This desk review provided an overview of the short-term impact of the project, as explained by the data generated during interim evaluation, and identified topics of conversation to be included in the interviews conducted during Phase 2.

In phase 2, an online survey was distributed to schools who participated in the second year of the project (which will be referred to as the Y2 follow-up survey). In order to enable a comparison between the first and second years of the project, this survey included key questions asked in the Y1 follow-up survey. It also asked questions informed by the desk review conducted in Phase One. In addition, follow-up telephone interviews

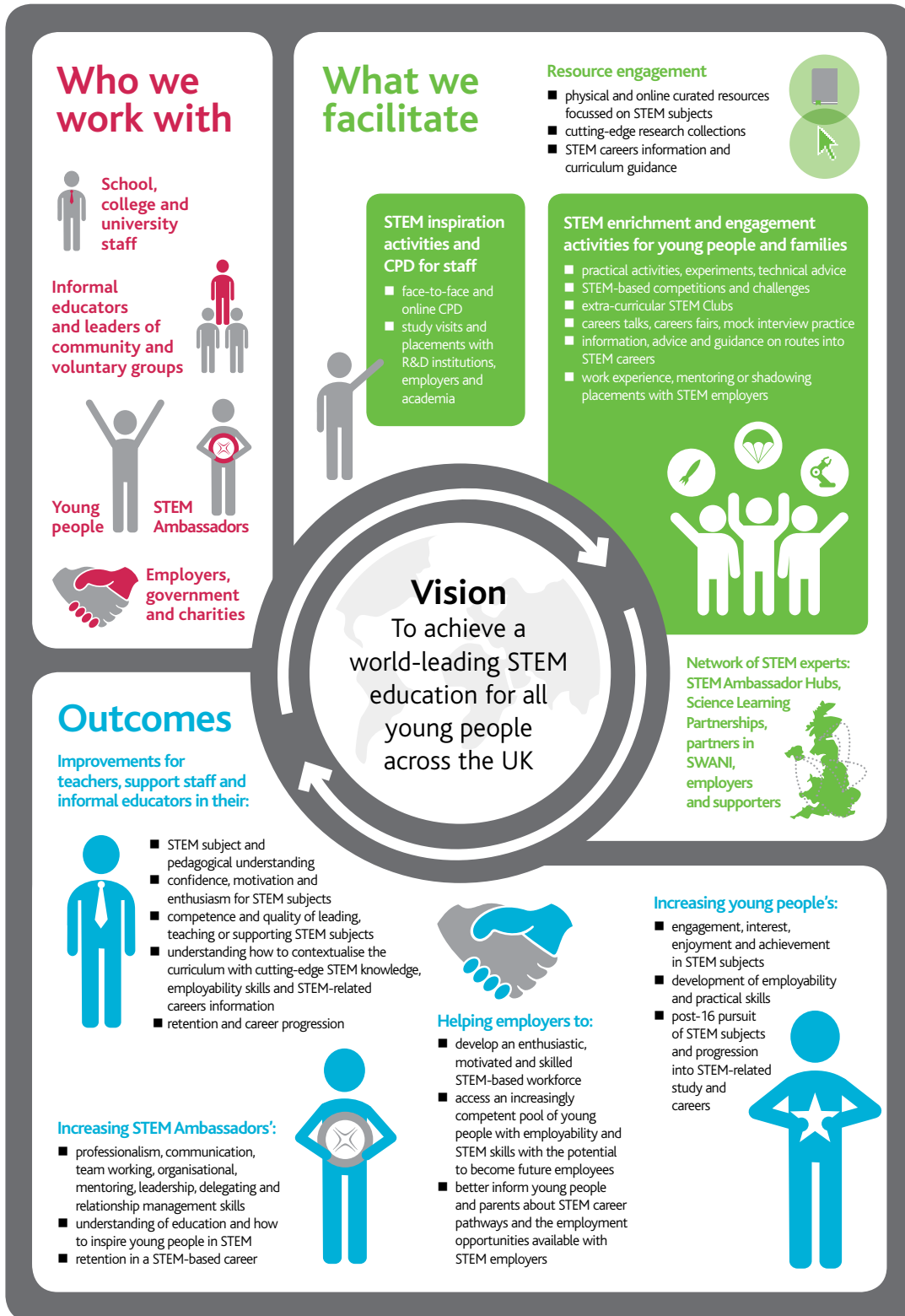
were conducted with 24 lead teachers for the project or head teachers in schools. During these interviews, five schools were identified as potential case studies, showcasing different ways in which the project was managed in schools. Data generation to develop these case studies involved school visits and face-to-face interviews or telephone and email exchange with the member of staff. The case studies were developed separately to this evaluation report.

The two key objectives of the evaluation formed the basis of a loose, inductive, bottom-up approach to analysis through the interpretation and thematic coding of the data⁷. This involved the identification of themes associated with the management and overall impact of the TPPP, which were later categorised according to the outcomes in the MoC. The data generated by the two surveys were analysed descriptively and where appropriate statistical comparisons were made between responses to the Y1 and Y2 surveys. The data generated by the two surveys was combined with the analysed, qualitative interview data.

3.1 Sampling

The Y1 follow-up survey was distributed to the 653 schools registered for the first year of the project. Sixty responses were received. The Y2 follow-up survey was distributed via email to the 747 schools registered for the second year of the project. A total of 95 responses were received from 91 different schools.

All of the SAs who had been employed to facilitate the TPPP were contacted via ESERO-UK to both take part in the evaluation process and to further facilitate access to schools. Nine SAs and 24 teachers (lead teachers for the project or Head Teachers) were interviewed.



► Figure 1: STEM UK's Model of Change

"You can tell OFSTED we're not going to teach them anything else for the rest of the year, because [the TPPP] is so good."

(Teacher)

This external evaluation aimed to assess the longer-term impact of schools' engagement in the TPPP on teachers, pupils and schools, and particularly to what extent the short-term impact (as presented in the interim evaluation²) has been sustained. In order to understand the sustainability of the short-term impact, it is important to ascertain the extent to which the impact described by the participants during the external evaluation reinforces or diverges from the results of the interim evaluation. Therefore, this section explores the impact of the TPPP, as described by the participants, in terms of the short-term benefits and the long-term legacy of the project. This impact is categorised according to who experiences the impact of the project and how that experience relates to the outcomes identified by STEM Learning's MoC.

Unless otherwise indicated, single percentages are reported below to represent the combined findings of the Y1 and Y2 follow up surveys: to take account of possible divergences, five questions were repeated in both the Y1 and Y2 follow-up surveys. No statistically significant differences were found between the responses to these questions.

4.1 On Pupils

STEM Learning's MoC, shown in Figure 1, outlines how their vision of a 'world-leading STEM education for all young people' aims to increase young people's engagement, interest, enjoyment and achievement in STEM subjects; development of employability and practical skills; and post-16 pursuit of STEM subjects and progression into STEM-related study and careers. Taking each of these points in turn, the following sections explain the extent to which the findings of the interim evaluation have been sustained.

4.1.1 Engagement, interest, enjoyment and achievement in STEM subjects

Looking first at engagement, enjoyment and interest in science, 100% of teachers responding to the impact surveys in the interim evaluation² felt that pupils' engagement had increased, which was echoed by 97% of respondents to the follow-up surveys.

Children were inspired and their interest was captured by the TPPP. They were particularly captivated by the launch and landing, but also enjoyed the science and broadcasts from space.

(Survey Response)

...since then children have taken notice of the items on the news about space travel and they know about the ISS.

(Teacher)

For example, there were pupils who were so engaged they did extra work at home that had not been set by their teachers.

And what we did do is discover quite a handful of children who really loved space and have since then brought in pieces of work that they've chosen to do at home or pieces of research...so I think it's just really... phenomenal, I wish I could do it all the time.

(Teacher)

In the Y2 follow-up survey, 27% of respondents felt that impact on pupils' engagement and enthusiasm for space and/or STEM education was the greatest benefit of participating in the TPPP; and this increased engagement has been the key motivation for teachers' continued engagement with the resources provided by the TPPP since the end of the project.

And the curiosity and enthusiasm of the children is tenfold when you've got a project like this going on every day. They were coming in asking questions.

(Survey Response)

There's just a higher interest in space things now, like an awareness.

(Survey Response)

Given the substantive positive responses from teachers, it is possible to conclude that the TPPP and more specifically, using space as a context for teaching, captured children's imagination, providing an opportunity for teachers to better engage children with science education. Future projects should identify opportunities to build on key science events to maximise opportunities for enhancing engagement, particularly those related to space and those involving role models that young people in the UK can identify with.

Most of the teachers interviewed were keen to get more girls interested in and engaged with science and the TPPP was able to provide a vehicle with which they could achieve these aims:

I think we certainly improved the interest and the uptake, particularly girls, that was my focus really to get the girls interested in STEM. I think we did do that so I think the legacy element of it certainly helps in that respect.

(School Science Coordinator)

One of the other schools entered the Astro Pi competition and the Year 6 girls got to the second round and it was really good, because it was girls again, they absolutely loved it.

(Federation Science Coordinator)

But [inclusion of Samantha Cristoforetti into the TPPP] made a lot of girls think oh okay I can actually do something with Science. I could do something with Physics. I could do something within that kind of domain as opposed to oh only men are astronauts or only men can go up in the international space station etc. So yeah it made a lot of girls interested in Science and that aspect of Science as well.

(Head teacher)

Engaging specific groups of young people in the TPPP project activities, who would otherwise not usually engage, can be explained to some extent by the increase in pupils' confidence of learning science and working scientifically reported by the teachers. In the interim evaluation, 99% of respondents felt that the TPPP increased pupils' confidence, which was echoed by 75% of respondents in the follow-up surveys.

We had a whole school competition where the children were asked to design their own planet and 75% of children from Year 1 to Year 6 entered.

(Survey Response)

Children enjoyed using space as a way of developing their working scientifically, such as finding out how craters developed, using fair test.

(Survey Response)

This increased confidence, as well as the way in which space provides a fascinating topic for use as a context for teaching and learning, meant that the TPPP was also a vehicle with which teachers were able to encourage active participation from young people who were usually passive, or had specific learning needs that made participation difficult. As the interim evaluation² also found, the TPPP increased engagement from pupils with SEND.

I've had teachers say to me that particular child there would have never ever behave like they have while we were running the Tim Peake workshops. You know we've had children who were really quiet come out of themselves and got involved. We've had the ones are not particularly good at science and maths are anything like that and again have come forward have been really engaged and totally enamoured with it all, so I think the impact has been huge.

(SA)

[The TPPP] enabled us to have a visit to the school from the mobile planetarium with the SA, which was a very exciting activity and engaged the interest of children of all abilities and all could engage on their own level, from children with SEN on a more sensory level to those that were able extend their knowledge about the solar system, space station etc.

(Survey Response)

For pupils the impact that stands out is the engagement and enjoyment of pupils with SEN or barriers to learning.

(Survey Response)

At the other end of the spectrum, the TPPP was also being used to develop activities for gifted and talented pupils, both in the schools registered with the TPPP, and with partner schools with whom they shared their knowledge and experience.

[The TPPP resources provided an] Opportunity for enrichment activities for children who are gifted and talented in related curriculum subjects.

(Survey Response)

The evidence suggests that the TPPP was beneficial for engaging different groups of pupils. Given the current and continuing interests in inclusive education and the gender gap in STEM qualification take-up and STEM careers, it is important that schools are made aware of the potential of projects like the TPPP for contributing to addressing these issues. Additional guidance and exemplars of good practice for teachers would be beneficial.

Evaluating the sustainability of increased attainment in science as a result of the TPPP is more complex. In the interim evaluation², 97% of teachers said that the TPPP increased attainment in science, which was only the case for 38% of respondents completing the follow-up surveys.

Higher pupil attainment (well above 90 per cent children expected or above in Y5 and Y6 in particular).

(Survey Response)

The children involved were enthused by the project and were able to undertake the Martian soil experiment. This allowed them to think more scientifically and enhanced their knowledge and understanding of space and working scientifically.

(Survey Response)

A scientist from Bristol University come in the other week ...and he was asking a few questions and the children were still remembering bits from their fortnight. So they were able to share that with him, so the knowledge is embedded which is great.

The impact is that the children are remembering being able to use it in a situation where they are questioned about science. Which again is a key skill that we're always trying to push through all of our subjects.

(School Science Coordinator)

Of the 24 teachers interviewed, all bar one felt that they were not able to assess the lasting impact on attainment in the long term for individual pupils. The main reason given is that the year 5/6 pupils who had participated in the project had moved to secondary schools at the time of the evaluation. Teachers also felt that as they were not teaching space/science at the time of the interview they could not comment on their pupils' ongoing attainment. For some, it seemed that because the TPPP had finished and they had moved on to other things, it was not possible to continue to measure the impact. This suggests that the impact of the project was seen in terms of engagement with the project itself, rather than more widely.

There are implications of teachers' (in)ability to judge whether or not attainment had increased. Although it was not part of the TPPP remit, CPD could include guidance that enables teachers to understand how to assess the impact of their involvement in such projects. As well as being used as justification for engaging in similar projects and the continued use of the project resources, such an evidence base could be used to promote the involvement of schools in future projects run by ESERO UK and/or STEM Learning.

One teacher interviewed did feel able to quantify how being involved in space/science-related projects (of which the TPPP was part) had affected pupils' performance in science. In Year 5, one cohort were at 62% for age expectations, whereas at the end of Year 6, they were at 97%. He was particularly impressed by the effect of the young people's engagement on their ability to think scientifically and engage with technical language.

And when eight and nine-year-olds are talking about 'streamlined' and 'air resistance' and 'thrust', it's great, it's great to hear that language... They can explain things much more confidently using scientific words, so has so many knock-on effects on the whole curriculum you know.
(School Science Coordinator)

This quote also highlights the wider impact of the TPPP on young people's attainment in other subjects. In the follow-up surveys, 45% of respondents felt that the TPPP had 'increased enjoyment/engagement/achievement in other curriculum subjects'.

4.1.2 Development of employability & practical skills and post-16 pursuit of STEM subjects/careers

The second and third outcomes for young people highlighted by STEM Learning's MoC (of increased development of employability, and practical skills and post-16 pursuit of STEM subjects and progression into STEM-related study and careers) are concerned with much longer-term goals than an evaluation of a primary programme after one year can indicate clearly. However, given the research evidence that increased uptake of STEM subjects post-16 begins with effective STEM education in primary schools, it is possible to assess the wider impact of the TPPP. The project could potentially positively affect outcomes in terms of young people's aspirations, increased knowledge of STEM careers, and the development of skills such as working in a team, communication and problem solving.

The TPPP was able to capture the imagination of the young people participating and engage them in learning and a lasting impact of this is of raising aspirations. To some extent this is down to Tim Peake himself.

...because he is somebody that the children can relate to. He's grown up in England, he relates well to people, he comes across as a down to earth person, and he managed to become an astronaut, which leads to the questions of how could I do that, but also the wider idea of getting into jobs.
(Teacher)

In the interim evaluation, 86% of respondents felt that their pupils had increased their knowledge of career opportunities available to those who study STEM subjects, while 45% of respondents in the follow up surveys felt that their careers knowledge had increased. Furthermore, there is also evidence showing that STEM career aspirations had increased (see Section 4.2.4).

Children who had no idea about STEM or space careers became interested, then passionate - it really opened their eyes to possibilities previously unknown. Even their families became interested.
(Survey Response)

Pupils and staff much more knowledgeable about space and space careers, pupils much more interested in space and space careers.
(Survey Response)

In addition to working scientifically, the skills that have been developed as a result of participation in the TPPP depend on the nature of the activities organised in schools. Some of the most notable are the team working and communication skills developed through the experiments conducted, but also as part of the wider project. For example, one school took a cross-age approach for the day such that new 'classes' were organised that contained a mix of pupils from across the year groups who then got to experience learning with new peers and a range of teachers they would not usually be taught by.

It was really nice to see it from an individual point of view of children achieving on their own through the whole class...
(Science Coordinator)

Although teachers were most enthusiastic about the impact of the project on uptake of STEM subjects and STEM careers during its implementation, nearly half of teachers surveyed remained convinced that the impact was sustained. This suggests that primary schools should be encouraged to continually provide young people with experiences such as the TPPP that raise awareness of the importance of science and STEM career possibilities, and that this awareness is sustained.

4.2 On Teachers/Educators and Schools

The focus on supporting teachers and informal educators in their professional development included in STEM Learning's MoC lists five outcomes established that were all identified within the longer-term impact of the TPPP on teachers':

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

4.2.1 STEM subject and pedagogical understanding

The TPPP increased teachers' subject knowledge and provided alternative ways of delivering the primary science curriculum, particularly in relation to the unit Earth and Space, through CPD and the resources available in the starter kit. The interim evaluation found that 98% of respondents (n=453) agreed that the TPPP improved opportunities for working scientifically. There is evidence that this impact of the project has been sustained: 50% of respondents to the follow up surveys (n=150) acknowledged that the TPPP continues to provide such opportunities and 56% feel better able to teach with real-life examples.

Gave some of their learning a purpose by linking it to real-life examples.

(Survey Response)

According to the teachers interviewed, these real-life examples could relate to continued use of the resources in particular or registering for other

context-based science projects (such as the Polar Explorer Programme¹, VEX IQ Challenge², or Digital Explorers³).

The continued use of TPPP resources provides the most tangible evidence of the longer-term impact of the project.

Resourcing is a massive issue within science and the amazing thing about the Tim Peake project is we were given so many resources and when we did the science, I literally just went look at all these books and all the resources we've been given to choose from here, the lessons are pretty much written for you. You just need to get your head around it and maybe go away and do a little bit of research. To just have that is what really makes the difference for us because it's the hours and hours of ideas and lessons that we could have done.

(School Science Coordinator)

Engaged the children, involved the wider community through a science fair, encouraged teacher participation and developed science teaching, provided a new and interesting dimension to working scientifically, particularly with the supporting resource.

(Survey Response)

Those teachers who continue to use the resources:

- are planning to use them the next time they are delivering the Earth and Space unit (usually taught annually or biannually to Years 5 and/or 6);
- have incorporated them into their schemes of work across the primary science curriculum and to a lesser extent across the whole primary curriculum;
- use them in the delivery of extra-curricular activities in school, such as science clubs; and
- use them in outreach work with other schools.

¹ <https://www.stem.org.uk/welcome-polar-explorer-programme>

² <https://www.vexrobotics.com/competition>

³ <http://digitalexplorer.com/>

I have the resources...I've structured lessons differently - the Martian soil experiment I have decided to put into filtering something [KS2 Science: Properties and Changes of Materials] or other parts of the curriculum so incorporated those space linked experiments in different topics.

(School Science Coordinator)

In addition, schools invested in equipment they were introduced to by SAs who brought extra resources for use with the TPPP. For example, a special needs school invested in Lego WeDo kits (a junior age robotics product range which links science technology engineering and maths) for schools to support practical activities in science.

According to those interviewed, the extent to which the TPPP increased teachers' subject knowledge varied from school to school. Teachers with science backgrounds did not feel that their subject knowledge had improved, but they acknowledged that the TPPP had helped to increase other teachers' science skills.

I think it's great for people who lack confidence and have that lack of specific subject knowledge.

(School Science Coordinator)

All teachers described how the resources provided ideas that helped them to teach science differently. In some cases this was a pedagogical shift, in others (such as schools who were already proud of their science focus or enquiry-based approach to science) it reinforced that they were already teaching in an engaging way.

It was really nice that it hit all sorts of boxes in terms of different learning, from independent, to partners, to group, to class. It was really nice that it was a very natural sort of path for all to go.

(School Science Coordinator)

...we already do quite a bit when we do the Space topic, we do lots of hands-on Science and so on, but it just gave us different ideas. It's quite nice, it had other experiments you can do and different things, extra resources, which is always nice because they're hard to find...

(School Science Coordinator)

The evaluation included interviews with home educators (parents educating their children at home) who were using the TPPP as a way to motivate their children to engage in learning – including those with a chronic illness and/or specific special educational needs. The TPPP provided a context within which they could approach learning in general, but also provided opportunities to think about learning differently.

...it's made me look at educating her in a different way as well - the more holistic approach to arts and crafts is just as important as writing pages and pages to show what you've learnt. And there are different ways of expressing yourself, which has been pivotal really for her because as I said there's some days when she can hardly write because of the pain in her hands. So for her to find another channel to express what she's learnt is amazing...

(Home Educator)

4.2.2 Confidence, motivation, and enthusiasm for STEM subjects

In explaining the impact of the TPPP on their school, improved teacher confidence was the most frequent survey response: 99% of respondents to the impact surveys (n=453) felt that teacher confidence in space topics had improved and this impact has been largely sustained given that 81% of respondents to the follow up surveys (n=150) agree.

Before we did not have whole school science days since joining TPPP I have been able to persuade teachers to take part in whole school science days by offering STEM Ambassadors and resources from the project.

(Survey Respondent)

Teachers were far more confident delivering material due to resources.

(Survey Respondent)

This increased confidence was attributed to the resources provided, as well as to the provision of a SA.

Well, [J] was amazing, she's just so inspirational and she brought in lots of really good resources and the children really, really loved her, she was fab with them, and her coming to do the CPD for us as well was really good for the teachers, so it gave them a bit of confidence...I think that was one of the main things that was really good.

(Science Coordinator)

They felt pretty well supported and the teachers felt happy, supported, confident and I think that came across in the students, and the students really engaged with it.

(Science Coordinator)

The SAs were asked how they viewed their role in the TPPP, and the answers varied depending on what they thought was the most important aspect of their work. For a number of the SAs, the development of teacher confidence was a key part of their remit.

I saw it as a role of being able to encourage teachers who often weren't confident teaching about Science and particularly Space, to work with children on a topic that actually I knew most children thoroughly enjoyed.

(SA)

...they were provided with CPD events and resources and the resources are out there, they can still go on download them and repeat them, but having the support of the space ambassador provides more confidence in using them and adapting them to their needs.

(SA)

When teachers' confidence increases, their enthusiasm for science increases as well as their creativity in delivering the science curriculum. This was clearly evident in the further exploration and use of the resources provided by the TPPP, such as looking again at resources that at first seemed too 'scary' as they were based more on chemistry, coding, or radiation. Their enthusiasm was also evident in schools' decisions to plan regular science/space/themed events or getting involved in other context-based primary STEM projects such as the Polar Explorer Programme. Teachers' creativity and confidence were clearly evident in their increased ability to take risks to teach beyond the curriculum,

and in so doing to situate the facts and skills that need to be delivered in a wider, more authentic context.

I think it was good for all of us to be able to talk to the children about something a bit new because we probably wouldn't have had the conversations about space.

(School Science Coordinator)

It can be quite difficult to get the children on board with things, and the staff also, and I regularly still have teachers say to me: "I loved that week, it was a great week"

(School Science Coordinator)

It really woke a lot of staff up to some of the things they could do, what they can do with space science.

(School Science Coordinator)

It gave them the confidence to be able to have a bit of fun with it. Turn the classroom into a space station, go off curriculum, and not worry about it. If children are asking you something and you go off piste so to speak don't worry about it, it's child-centred learning and just bring it back at the end of the day. You know you've hit some of the skills, it doesn't matter if you haven't done them all and then refresh and plan for the next day.

(School Science Coordinator)

This increased confidence in teaching science, but also in getting involved in other projects, extends to the home educators involved in the TPPP: especially with regards to the provision of resources, and their experience of being included in a project that they felt would only be targeted at schools. Consequently, they were encouraged to explore possibilities of getting involved in other projects or emailing key new contacts. One mother described how she and her daughter have so far set up correspondence with researchers in universities, ESA and NASA, to ask for information or answers to questions.

It's made me a lot more confident in putting my head above the parapet to ask if we can access things, or try and find things out to get information for what we need to do...

(Home Educator)

4.2.3 Competence and quality of leading, teaching or supporting STEM subjects

In the interim evaluation, 98% of respondents (n=453) to the impact survey felt that the TPPP has been successful in raising the profile of space, and consequently STEM-related subjects, in primary schools; 60% of respondents (n=150) to the follow up surveys felt that this impact had been sustained over the course of the following year. This impact is evident through schools' applications for the Space Education Quality Mark (SEQM) or the Primary Science Quality Mark, an increase in science-themed activities and, in one school, the creation of a new science role on the staff.

We developed a post of science lead.
(Survey Respondent)

We used the work done in school to support our application for the primary science quality mark.
(Survey Respondent)

Raised profile of science in school. We now regularly have visitors in or do whole school events e.g. science week.
(Survey Respondent)

Teachers and SAs both felt that such profile raising was important in relation to the current policy of prioritising literacy and numeracy in primary schools that can be at the expense of time spent on science and other subjects.

Science Leaders/Coordinators were especially pleased with how the TPPP has enabled them to engage other teachers in the school in STEM subjects and therefore raise the profile of science in terms of teaching other subjects through science contexts such as space.

[The TPPP is] the only thing as a leader that I've done in a staff meeting that everyone was like yeah, wow, exciting. And to get that reaction was amazing, because there's always a few people that are reluctant and there's always a few people that are oh I can't fit it in, I can't do that. But we didn't have that reaction, so

the fact that all the teachers were really enthusiastic I think meant that they spent a lot more time devising activities to actually do with the children...

(School Science Coordinator)

One of the hurdles that both SAs and teachers mentioned, was the perception that teachers could not teach science without specialist equipment. In taking a small budget approach to developing practical equipment for some of the experiments featured in the TPPP resources, with items that could be purchased at a local discount supermarket, SAs were able to help teachers to better support learning in STEM through enquiry-based learning. Understanding that they could develop their own sets of equipment, without relying on fancy or expensive items, has increased the quality of teachers' science lessons as they are able to deliver more practical activities than they had previously thought possible.

...so when teachers see that you're putting stuff together, they think well yeah very little outlay and I've got a resource which I can use.

(SA)

As the TPPP increased teachers' enthusiasm, confidence, and motivation for science teaching, they were able to adapt schemes of work, in science and other subjects, to incorporate resources from the TPPP and their own bespoke resources, as well as adapting their teaching practice. These adaptations have enabled some teachers/schools to meet external requirements on their teaching, namely performing for Ofsted inspections and, in Wales, meeting the requirements of the Donaldson Report.

I did maths, a lesson all about time and Tim in space and how many minutes between when he did this and this, loads of activities like that so I did that as a maths lesson. I did that in Year 4, 5...I did that for Ofsted...I had photographs of Tim's day and they had to sort of put them in order and then work out the time between the start and the end of his activities and yeah, I think it went well.

(Teacher)

We are looking at all of our schemes of work and pulling out all the projects and elements that are working at the moment because we're changing our planning to fit into the Donaldson report and the areas of learning. We will be looking to pull through more of the [TPPP] activities... as we change our topics and schemes of work in the areas of learning for the Donaldson report.

(School Science Coordinator)

The Donaldson Report⁴ in particular outlines a number of expectations of teachers, which include: setting tasks and selecting resources that build on previous knowledge and experience and engage interest; creating authentic contexts for learning; and encouraging young people to take increasing responsibility for their own learning. The TPPP provided a useful opportunity for the school above to pilot a way of working that met these requirements of the report. Namely, that they planned their delivery of the TPPP in consultation with the pupils, asking them to develop questions on space which the teachers then answered during a Space Fortnight using the TPPP resources. The competence of the teachers in being able to adapt the TPPP resources to the situation is clearly evident here, as well as a wider impact of the ability of the TPPP to develop science capital in both teachers and pupils. When teaching any subject, including science, it is important that teachers understand their pupils' starting points and scaffold their learning to move forward from that particular position. This includes an understanding of their backgrounds and everyday contexts, and what is particularly relevant and interesting to them. Using the TPPP for an enquiry-based approach to learning, in which the pupils defined the direction of the enquiry, highlights the adaptability of the TPPP to the context within which it is used.

4.2.4 Understanding how to contextualise the curriculum with cutting-edge STEM knowledge, employability skills and STEM-related careers information

Space continues to be used as a context for teaching in schools: 57% of respondents (n=150) to the follow up surveys said they regularly use space as a context for teaching; and 38% did so occasionally. Just five schools no longer used space as a context for teaching, and three were not doing so at the moment, although they planned to in the future - due to topics being rotated in the curriculum. The most common way of using space as a context for teaching was to enrich curriculum teaching in science (90%, n=150). This was followed by cross-curricular teaching in other subjects (67%); arranging school events related to space (30%); and supporting extra-curricular activities - such as science clubs (37%).

There are schools (e.g. 17% of the teachers interviewed) that only use(d) the TPPP within their science teaching and their continued use of the resources, if they intend to use them again, is confined to the delivery of the Earth and Space unit of work. For those schools who chose to extend the use of the TPPP resources to literacy, numeracy and other subjects, using space as a context for teaching is an aspect of the TPPP that has had a larger, and in some cases more sustained impact on educators and schools. This larger impact is mostly due to the development of a whole school event that gave the TPPP, and consequently space education and science, a larger profile. The sustainability of this impact has therefore continued in those schools that have chosen to repeat such events in the future and/or to incorporate the TPPP resources into schemes of work across the curriculum: impacting teachers' practice and students' engagement.

⁴ <https://www.nasuwt.org.uk/asset/A788604C-3046-4005-A1EA0EAF023E0DD/>

In the Interim evaluation, 99% of respondents (n=453) to the impact survey felt that the TPPP provided opportunities for cross-curricular learning through the context of space. In the follow-up surveys, 60% of respondents (n=150) felt that they had increased confidence in using space for cross-curricular teaching, providing evidence that the impact of the TPPP on cross-curricular teaching has been sustained.

The TPPP led us to thinking about training to become an astronaut and we adapted circuit training sessions for this - this improved physical fitness and also improved Maths skills as we measured and recorded progress.

(Survey Respondent)

More teachers can see the cross-curricular possibilities in maths and literacy through the measurements and inspiration provided by using space as a topic.

(Survey Respondent)

To some extent, confidence in using space as a cross-curricular subject is connected to the role of the TPPP in encouraging teachers to share practices and resources: 97% of respondents to the impact survey (n=453) and 41% of respondents to the follow up surveys (n=150) felt that the TPPP encouraged such sharing. As the project is modelled on the idea of a SA sharing their experience and knowledge of STEM education, it follows that sharing be a natural part of how it is delivered. Such sharing extends beyond schools in some instances: in the Y2 follow-up survey, 14% of respondents were using the context of space to engage and collaborate with other schools. For example, one science coordinator interviewed explained how they were using TPPP resources in outreach activities with other schools that included art competitions and workshops for gifted and talented pupils. However, increased confidence in cross-curricular use of space as a context for teaching, through the sharing of resources, is not a universally evident impact. Of the teachers interviewed, 25% delivered all of the TPPP activities that ran in their schools, and 44% (n=150) of respondents in the follow-up surveys worked in schools where only one or two teachers were involved, which does not imply that resources were shared widely.

The impact of the TPPP in boosting confidence through encouraging the sharing of resources is therefore larger and more sustained in schools that took a wider, whole school approach to the project. In such schools space was used, and continues to be used, as a context for cross-curricular teaching of English/literacy, maths/numeracy, art, PHSE, DT, PE, ICT, music, history, geography and modern foreign languages. Space is also being used in regular themed day/week/term events, or as part of extra-curricular activities such as science clubs, space camps and museum visits scheduled to coincide with TPPP activities. After science, the interviewees suggest that TPPP resources continue to be most often used in numeracy and design technology subjects, closely followed by literacy. Given the applicability and success of the TPPP for cross-curricular teaching and learning, initial promotion of future projects and contact with schools could focus on the value of contexts such as space in engaging young people in literacy, numeracy and other subjects – particularly if backed up with evidence of increased attainment in these subjects.

As a result of the positive impact the TPPP had on young people's motivation and learning, teachers were more likely to recognise the benefits of using authentic contexts, such as space, for learning. Indeed, a number of teachers and home educators mentioned registering for or becoming involved with other authentic context STEM-based programmes such as the Polar Explorer Programme or Rocket Seeds project, which contributed to the results of a scientific study.

It was wonderful to be involved with something that was real, not just you know, a textbook, and the rocket seeds thing was amazing, you know to actually have these seeds that had actually been in Space; to be genuinely doing something proper was wonderful. It has continued in that we have taken part in things like the BBC Terrific Scientific since because there was such a motivation from taking part in these mass-participation things, I've seen that first hand.

(School Science Coordinator)

As the quote suggests, the rocket seeds project, although not directly a TPPP resource but run alongside TPPP activities, provided an opportunity for young people and teachers to be involved in a scientific study that was directly linked to Tim Peake's time in space. It was also realistic in terms of the problems faced by scientists in real life situations of experiments not always going to plan. Should Tim Peake or another British astronaut return to the ISS, it is suggested that similar projects be designed that involve teachers and pupils, providing them with an opportunity to become engaged in 'real science' and increasing their engagement in teaching and learning STEM. Similar projects could also be developed for projects that feed into other context-based approaches to STEM that follow the same model as the TPPP.

For a number of schools, maintaining the momentum of the TPPP and continuing their use of space as a context for teaching can be difficult within a culture of competing priorities.

...being able to get [teachers] to realise that actually they can still do the numeracy and literacy within the project was helpful, but at the end of the day when the school has bought in to a package [such a primary curriculum teaching package] and they are grinding their way through that package because they have to, because they're being measured against their outcomes in certain areas.

(SA)

Such pressures can be resolved to some extent with an explicit emphasis on how other outcomes of primary education, such as literacy and numeracy targets, can be met using resources and contexts such as those provided by the TPPP. A sheet linking the resources in the starter kit to the different areas of the curriculum, and potentially how they feed into the various primary curriculum teaching packages available, would also make engaging with similar projects more straightforward for teachers feeling those pressures.

Another barrier to sustaining the impact of the TPPP, that could be resolved to some extent with such a guide to the resources available, relates to teachers'

ability to capitalise on current events for STEM teaching and to maintain that STEM focus after the event is over. For example, two of the teachers interviewed felt that the success of the TPPP was its focus on a mission that was seen as historic, and it can be difficult to maintain that focus after the media buzz is over. This resonates with SAs describing the difference in approach to Y1 and Y2 of the TPPP. In that the first year activities could be more closely linked to the 'wow factor' of key points of Tim's journey to the ISS and his stay there (launch, spacewalk, etc.), and the second year, when Tim had returned, provided more opportunities to explore the science in more detail. Therefore, similar projects should incorporate a guide to resources as described in the paragraph above as well as outlining potential sustainable impacts of the project explicitly, during the CPD provided by the SAs.

Finally, teachers felt that their ability to talk about STEM-related careers increased after being involved in the TPPP and this had a knock-on effect on the aspirations of their pupils.

...there's the ones who have always wanted to be a writer or something like that, but there's definitely more thinking of science and technology type careers and the parents have actually said that in parents evening as well.

(Teacher)

...[the TPPP] certainly made them much more excited about Science, but it really helped give us a fantastic context to talk about a huge variety of careers that involved using science and that the wealth of careers behind getting an astronaut into space. But it's not all about the astronaut, that actually there are thousands and thousands of people involved and really looking at a lot of that and children talking about how they'd like to do that when they're older. So it gave us a really good focus for talking about careers.

(Teacher)

Both the resources provided (although they could be further developed – as explained on page 29) and the SAs helped teachers better understand the range of careers available to students opting for STEM subjects, particularly those related to space. Of those respondents to the Y2 follow-up survey who were continuing to use space as a context for teaching, 14% were using it to support their careers education. Therefore, the TPPP has had an impact on teachers' ability to communicate STEM career options to the young people they teach and consequently in raising the aspirations of pupils to consider these careers.

4.2.5 Retention and Career Progression

The impact of the TPPP described by teachers was mainly concerned with their ability to teach and support their students' learning, rather than its impact on their career progression, but there is evidence of how schools' involvement in the TPPP has provided opportunities for teachers to progress. For example, one headteacher interviewed had recently made a 'good appointment' of a science specialist teacher to the school and a survey respondent highlighted that a new post had been created at the school for a Science Lead Teacher. In addition, the achievement of good Ofsted inspection grades or becoming teaching ambassadors for science in their local areas (especially the instance of one SA interviewed who was a school teacher in the first year of the TPPP and became a SA for the following year) are also evidence of career progression. One teacher in particular mentioned how using the TPPP across the federation of schools he is science coordinator for, has added to his experience and assisted the trajectory of this career to help obtain the role of setting up STEM hubs across his region, to share good practice and CPD.

In terms of teacher retention, the evaluation did not explore this directly, but suggests that the TPPP may have had an impact: research evidence shows that job satisfaction and enjoyment make teachers more likely to stay in the profession and the TPPP has increased teachers' enthusiasm and motivation for teaching. Furthermore, research also shows that engaging with STEM Learning CPD increases the chances of teachers remaining in the profession⁸.

4.3 On Space Ambassadors

We are not 'doing space' we are 'doing it through space'.
(SA)

The above sections, which discuss impact of the TPPP on teachers and pupils, focus on the extent to which impact found in the interim evaluation was sustained in the year following the project delivery in schools. This section, and the one that follows, report the impact of the TPPP on SAs and on the wider community, which was not reported on in the interim evaluation. Considering SAs first, STEM Learning's Model of Change (MoC), shown in Figure 1, includes outcomes that focus on the professional development of STEM ambassadors and participation in the TPPP has had an impact on SA's career development.

SAs are by and large motivated and enthusiastic about what they do, and a key impact of working on the TPPP in particular was the focus on Tim Peake himself. Just as pupils and teachers have been inspired by the project, the SAs were equally enthused.

Tim Peake is 'just like your dad', but he's an astronaut!!!
(SA)

And this enthusiasm rubs off.

Universally every space ambassador is still working with a teacher that either has a science background or who caught the bug and really likes space - and they sell that to the kids.

(SA)

Therefore, the continuing professional development of SAs and their enthusiasm for the TPPP have had a lasting impact on the teachers and pupils they interacted with as part of the project.

From the evaluation data, there are three main areas of long-term sustainable impact of the TPPP on SAs' career development: the continued use of resources provided/developed as part of the project; the increase in SAs confidence to better support schools; and access to larger professional networks.

4 | The Impact of the Tim Peake Primary Project

SAs received training in how to deliver the TPPP and access to the resources included in the starter kit. In order to deliver some of the activities found in the kit, SAs developed their own equipment to take into schools.

For me, the impact has been about developing my delivery and how to adapt resources.

(SA)

In addition, some SAs provided resources for use in the TPPP, which were extra to those contained within the starter kit. The development of such a bank of resources, and their use in schools to model approaches of delivering STEM activities, is an illustration of the added value that SAs bring to schools that supports the sustainability of the project outcomes - especially when schools later invested in similar equipment to support their continued teaching of science. The continued use of these resources by SAs in future work with schools and STEM projects is also a sustainable impact of the TPPP. For example, one SA described adapting activities from the TPPP for use in delivering activities requested by schools as part of the PEP.

The SAs interviewed spoke highly of the longer-term impact that facilitating the TPPP has had on their career development in terms of their confidence of being a SA and delivering the project effectively.

The impact on me as adviser has been phenomenal as obviously I've now got this massive relationship with all of the schools which run the TPPP. A lot of them, well pretty much all of them have been really complimentary on how I ran it, so that built my confidence to do other projects.

(SA)

I learnt a lot myself doing outreach going into schools and engaging the children, not just as the teacher, which I had been for 16 years previously - so I actually learnt a lot myself about how to [engage with schools as an ambassador]. And on the back of a lot of it I actually created some stage shows.

(SA)

As the quotes suggest, involvement in the TPPP taught the SAs about their own capabilities for the delivery of

the project, how to interact with schools as an adviser and for some, how to work with young people.

Working with the schools registered for the TPPP, means that SAs have had local involvement and have been able to build networks of schools through this direct relationship, or because they have been contacted by new schools after they heard about the TPPP. A number of SAs remain as local points of contact for schools, for example, for resource suggestions or links to other projects. This ongoing contact provides opportunities for SAs to continue to deliver STEM activities in schools and develop wider audiences for future work. A number of SAs have moved on to take up roles as a Polar Ambassadors as part of the PEP - two of whom were interviewed.

The networks developed by the SAs as a result of their work with the TPPP extend to include other educational practitioners and space ambassadors, as they were able to take advantage of a forum set up to help them share their experiences of the project and get together at local and regional meetings. These networks provide a community with which they can explore new ideas, work together on different projects and/or apply for new sources of funding. One of the SAs also mentioned the intellectual impact of belonging to such networks.

The use of SAs in the TPPP therefore had multiple levels of impact. They saw their longer-term impact on others in terms of the role of SAs to motivate teachers and pupils and increase their engagement in STEM, as well as promoting the work of the European and UK space agencies. The TPPP also benefitted SAs by providing useful professional experience, access to resources that they can continue to use, and the development of professional networks that provide a larger audience for their work as well as critical friends.

...inspiring teachers...that space is a context that can be used anywhere and that space is not just a topic for year 5.

(SA)

Space ambassadors are a point of contact, but also specifically advocating for ESERO, the European Space Agency and the UK Space Agency.

(SA)

4.4 Wider Community

The impact of the TPPP on parents, grandparents and the local community in which schools are situated, unlike the impact on teachers/educators and pupils who participated directly in the project, was not reported in the interim evaluation. Schools' involvement in the TPPP also benefitted members of this wider community. For example, Tim Peake's mission to the ISS captured parents' imagination. Teachers talked about how parents were either motivated by their children's engagement in the TPPP and space, or interested in it themselves, and the number of visits to space or science centres and the like that young people were taken on at weekends increased. There were also instances of parents instigating extra projects at home, such as building rockets or models of the ISS.

I mean the impact on parents, children going home... telling parents about Tim Peake, of things that they've done, and then there was something on the news about Tim Peake. I think there was probably a lot of conversations going on at home that reinforced everything.

(SA)

A number of schools capitalised on their involvement in the TPPP to develop opportunities to engage parents, and in so doing extended the impact of the project to include the wider school community. For example, planning a 'cycling to the moon challenge' – adapting the train like an astronaut resources – where the pupils all contributed to the distance of cycling to the moon using bikes at school, and parents could contribute to meeting the challenge by measuring the lengths of bicycle trips that they took their children on. Elsewhere, SAs, and/or teachers, had links with the Astronomical Society, or local astronomy groups, universities and/or industries. Therefore, the programme of activities could include solar viewing using telescopes, stargazing evenings or meteorite handling sessions and parents, grandparents and members of the local community were invited in to schools to take part in the interventions organised

by space ambassadors. Parents were also asked to assist with activities such as engineering workshops to build solar-powered cars, learning in the process, or brought in to contribute their knowledge, such as afternoon tea with grandparents to talk about their memories of the first moon landings. At the very least, the community involvement stretched to open afternoons for parents to come in and learn about the TPPP through the work the young people created.

There was a real buzz about the place. It involved not just the school, it definitely spread to Governors and to families as well, because I started it off by asking children to make a model of the International Space Station...so some of them got together in groups of friends, and people's granddads got involved. And you know they all met in somebody's shed on a Saturday afternoon, and they came in with the most amazing creations which were all teamwork.

(School Science Coordinator)

We also made some scrap books to involve the families, the influence was that everybody could join in. We asked children to interview grandparents about what they remembered about the first moon landing, and then to speak to them about what they thought of how Tim Peake on the Space Station compared with that, and how things had changed...then we had comments from children in reception about what they'd thought of Tim Peake in the Space Station...so there were all ages in this book; it went from 94 to 4.

(School Science Coordinator)

Therefore, while some schools set out to use their involvement in the TPPP to develop stronger links between the school and parents, other schools built upon the enjoyment and engagement of the students by engaging with parents, grandparents and the wider community – sometimes this engagement was instigated by the parents themselves, without the teachers intending to engage them. Such community involvement not only increased the impact of the project, but also the engagement of the young people in the TPPP, 'because they felt part of something big'.

4 | The Impact of the Tim Peake Primary Project

The wider communities in which schools are situated, also includes their connections with other schools, and the TPPP had an impact on existing networks and the development of new ones. The most obvious area of impact in this regard was the opportunity for teachers from different TPPP schools to meet each other and network during CPD sessions provided by SAs, or to share good practice using the online community forum set up as part of the project. However, while three interviewees mentioned such networking, and a couple of SAs talked of their intentions when giving the CPD to groups of teachers from different schools, the evaluation did not capture a detailed overview of the extent to which this networking was useful beyond having an awareness of other schools in the area and the organisation of joined up events. There were other, more specific examples of networking and the role of the TPPP in strengthening or developing those networks.

In one area of the country, the coordinator of a newly set up network of schools, developed by another STEM initiative, encouraged the network members to register for the TPPP as it promised to provide excellent opportunities for developing relationships between teachers involved in the network as they shared planning and practice of the project. The network coordinator, a teacher at a local sixth form college, was later invited to be the TPPP SA responsible for supporting the area, including the 11 schools in his network. Being involved in the TPPP strengthened the relationships between the schools and was the catalyst for the continued development of the network.

Networking between schools has also extended the reach of the TPPP to schools who were not officially registered for the project. For example, a number of schools belonged to STEM cluster groups, academy chains or federations of schools, with which they shared their experiences of delivering the TPPP and the resources from the starter kit. Other schools have started outreach work, developing their experiences of the TPPP to provide CPD or advice for teachers at other schools, and/or organising events that bring pupils from these other schools to their schools to learn about space.

In addition to the schools sharing their experiences of the TPPP, SAs involvement in the TPPP has also had an impact upon schools that were not registered with the project – as well as wider communities of learners. The main reason for this impact is linked to the use of resources. In order to deliver some of the activities found in the TPPP starter kit during workshops with the pupils, SAs needed to develop a bank of resources. For example, conducting a class experiment requires that the SA have the equipment needed to run the activity. Each SA therefore finished the project with an individualised bank of resources, that includes the TPPP starter kit, any equipment they put together to deliver the starter kit activities, and resources that they may have brought into their delivery of the TPPP. These resources are ready for use in their future work with other schools and, for some SAs, in engaging wider audiences at large exhibitions and county showgrounds, with Scouts and other youth groups, and as part of STEM/Space themed stage shows.



► Space Ambassador Graham Colman showing the orbit of the ISS with a hula hoop at his TPPP stall at the Royal Norfolk Show

A number of the SAs are advanced skills teachers working in secondary schools and sixth form colleges, who were involved with the TPPP alongside their secondary level teaching. Two of the nine SAs interviewed mentioned how they used their expertise and knowledge to further develop some of the resources and activity ideas to deliver aspects of the secondary science and post-16 curricula, as well as to enhance the programme they deliver as part of advanced skills teaching partnerships with other primary/secondary schools. The resources are therefore having a wider impact than originally intended when they were developed for primary school communities and, given their continued use with a range of audiences, highlight the benefit of space as an engaging context for learning in formal and non-formal learning environments across different age ranges. Adapting the TPPP for use with secondary schools, and/or youth groups such as Scouts or Guides, is therefore recommended.

Some teachers/educators also talked about the opportunities to work with the community that they had not thought of during the official period of the project, some of which have been previously organised by other schools participating in the evaluation. For example, organising star gazing evenings or getting involved with space camps and bringing parents in for part of the event. One parent home-schooling her daughter was considering a YouTube channel:

The children at the home education group want us to actually set up a YouTube site to show our science experiments and stuff at home so others can learn from them and follow.

(Home Educator)

In summary, the TPPP increased teachers' confidence of teaching STEM subjects, and using space as a context for teaching and learning increased pupils' engagement, interest, and enjoyment in STEM subjects. The impact of the TPPP on young people's engagement in STEM continues to be sustained, especially in schools that continue to utilise the resources provided for use in delivering the project. The increased engagement of their pupils was a key motivation for teachers' embedding their use of the resources into the delivery of the curriculum and,

in a number of cases, for schools' later engagement with other projects that promote context-based approaches to cross-curricular teaching and learning. The impact of the TPPP also stretched beyond schools, as teachers were able to engage parents, grandparents and the wider community as well as networking with other schools not registered with the project.



► Solar-powered buggies made by Heron Class, Ludham Primary School

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"I think the project has given the teachers more enthusiasm for science. It's definitely given the children a lot more enthusiasm and I've actually started up a science club as an after-school activity. That's probably on the back of the enthusiasm of the children and wanting to keep it going."

(Science Coordinator)

This section of the report begins with an evaluation of what project management for the TPPP meant in practice, before exploring the three main structural elements that affected teachers' experience of the project: the provision of resources; CPD and SA support; and communication and paperwork.

5.1 Project Delivery in Schools and Education Centres

In the words of one SA, the TPPP was conducted within a 'light touch' management structure. The SAs recruited came from a range of education and/or industry backgrounds and therefore brought different areas of expertise to the project. The SAs were provided with training specific to the project and assigned schools according to where they were based in the country. They were then able to provide CPD sessions to teachers, to explain the project and the resources included in the starter kit, as well as undertake and/or support activities in the schools. The approach taken by the SAs had an effect on how the project was delivered in schools. For example, the SAs interviewed either spoke of showcasing science in particular or of a cross-curricular approach to science as being central to the TPPP. These different starting points will have had an influence on the activities organised – especially for those schools who had not formulated their own ideas of how the TPPP should be delivered.

However, the influence of school culture, and more specifically leadership, was extremely important to how the project was delivered. Of the schools represented by the teachers interviewed, a whole school cross-curricular programme was often organised when the headteacher had either instigated or championed the project and these programmes tended to have more of an impact

on teacher and pupil engagement, and the longer-term sustainability of this impact. In one example, a head teacher introduced a CPD session for the whole school by explaining that teachers do not tend to stay within a particular year group and they would therefore be gaining skills that they could take with them. Of the 150 respondents in the two follow up surveys, 41% were involved in a whole school approach, which ranged from the facilitation of a Science day/week/fortnight or a cross-curricular space day/week/fortnight, to the integration of space related activities across the curriculum over the course of a term/year.

Championing the idea of having a cross-curricular whole-school space week or longer-term project with the schools was described by SAs as effective to some extent in getting a school to more effectively engage with the TPPP. This was especially so when they addressed concerns over the loss of curriculum/teaching time for literacy and numeracy from the outset, by emphasising the use of space as a context for teaching these – but it was not always successful. For example, SAs mentioned that a number of teachers they worked with thought of space as a subject that was delivered to one year group only (e.g. year 5).

...that mentality was tough to crack...they would still turn around and say can you come in on Wednesday because that's when we do Year 6 science. That was frustrating.

(SA)

In addition, there were instances related by SAs, in which the teachers who attended the CPD were interested in getting involved but their head teachers and/or other teachers in the school were not interested - because of the time required to plan activities or the lower profile of science in schools compared to literacy and numeracy.

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In the 44% of schools where only one or two teachers were involved in the TPPP project, delivery typically took a single year group and/or science-only focus. Year 5 students were the most frequently involved in the TPPP (43%), mainly because this is when most schools teach the 'Earth and Space' module of the primary curriculum. More should be done to ensure whole-school buy-in in future projects by outlining the potential benefits of participation (for staff and pupils) and the strengths of running such a project with the whole-school and/or as a cross-curricular project.

When the schools had a target to aim for, or a goal to be met, that the TPPP was able to facilitate, this goal was instrumental to how the project was planned and delivered. For example, schools that wanted to work towards the SEQM used the requirements of the award to plan their activities. Those aiming to achieve the mark, and others who see the value of partnership with the wider community, included activities that brought parents, grandparents and other community members into the school and/or took the pupils out into the community, universities and science centres.

One Welsh school described how the TPPP was able to help them meet the standards described by the Donaldson Report: the TPPP provided an authentic context for learning and a platform with which the teachers could encourage the students to take responsibility for their own learning. The school developed a Space Fortnight programme in consultation with the pupils, who were asked to develop questions that they wanted to ask about space. The science coordinator then cascaded what she had learned in the CPD session with the SA and the staff used the resources in the starter kit to develop activities to answer the pupils' questions. This second example, also highlights how teachers' previous skills and experience, or confidence in their own abilities, affect their ability to embed programme activities in a creative way – for example, being able to modify the TPPP activities to bring in additional dimensions to support enquiry-based learning and collaboration between colleagues.

Another factor that affected the delivery of the project was when the SA began working with the school. The first 'time' aspect relates to when a SA was able to

start talking to the school about the project and how much time that provided for planning:

...getting into schools well in advance so that they can plan. Most primary school teachers plan from May and June onwards. July is out of the window... so when you are actually sending stuff out in July they are not going to pick it up until September and that's not a good time. Then there is no chance of getting anywhere near a primary school in December.

(SA)

The second relates to the year in which the project took place. As is the case with most new projects, the administrative aspects the project ran better in the second year, there were more resources developed for this cohort, and the SAs were more confident and able to build on their experience to be 'more proactive', but the focus of the project also shifted slightly in the second year. As the first year of the project ran alongside the Principia mission and Tim's stay on the ISS, there were key milestones through the year (such as the launch, his first spacewalk, tweeting from space, the return journey etc.) around which the activities delivered by SAs focused – often at the request of the schools. One SA described this first year as being more about the 'wow factor of the mission' and the second year as focusing more on the science of space.

5.2 Provision of Resources

The resources provided by the TPPP were identified as the most important aspect of the project: 93% of the respondents to the follow-up surveys rated these as crucial or very important. It cannot be emphasised enough how important ready-made resources are for primary teachers, particularly given how busy they can be. Having resources that can be clearly linked to curriculum aims, but can also be tailored to meet individual needs if necessary, can make a huge difference to the success of a curriculum project such as the TPPP. Future projects should use the TPPP resources as a model of excellence (given the positive feedback received) but also take account of the specific pointers below on how resource provision could be improved further.

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The main reasons given for the resources being an important aspect of the project, related to the high quality of the resources, the choice available within the box and the degree to which they were easy to follow – providing activity ideas teachers could 'pick up and run with'.

Teachers are like magpies. When they've got something there and time and everything is so precious, just to be able to have such lovely, colourful, useful resources is absolutely brilliant.

(Teacher)

The resources provided access to materials that schools would not have been able to locate or purchase themselves and teachers particularly appreciated that these were ready-made teaching resources that covered the whole age range.

We had all the astronaut cut-outs, the little things that would take us more time to do, just to have them readily available, illustrations and things like that were great because it was a matter of just going to the photocopier, getting that done and that was another resource for X number of pupils.

(Teacher)

The range of resources, including activities that could be used across the curriculum, was a particular attraction. For example, using Mission X activities for PE classes, The UK Space Agency's (UKSA) space food pack as an extension to the Farmyard to Fork to focus on food, or using models of the solar system and/or meteor craters to focus on mathematical skills such as measuring, were all highlighted in multiple interviews with teachers. Some science specialists felt that the resources (and the related CPD) did not improve their own knowledge of the subject, but the box of resources provided new or novel activity ideas that informed their teaching. One felt that the resources provided a 'launch pad' from which he was able to develop his own ideas.

I don't stick to any scripted stuff, I would just use it as a starting point and then sort of build on top of that.

(Teacher)

Therefore the TPPP resources enabled a degree of flexibility on the part of the teachers, in that they could be used as a complete package for those with

less confidence, or adapted to suit the needs of more experienced teachers.

Having a bank of ideas was a particular advantage when the TPPP had a whole school focus and all teachers were expected to deliver space-related sessions.

I think it did probably support the teacher who did lack confidence in science and who found the materials more supportive in terms of giving her background knowledge etc...I think it's great for people who lack confidence and have that lack of specific subject knowledge, in her case the majority of it enhanced what we had.

(Teacher)

Teachers appreciated having access to physical copies of the resources, which was a definite positive of the starter kit, but also having a digital backup to assist with their development of presentation slides and other electronic teaching aids.

The most commonly used resources include Mission X, the Rosetta Pack and solar powered buggies. Cosmic Classroom was mentioned by some as providing a 'wow factor':

The space classroom live link with Tim was the most valuable experience of them all. The children were blown over by it, especially being live.

(Teacher)

In one federation of schools, a student's tweet about the link was later re-tweeted by Tim, which subsequently increased the pupils' interest and engagement across the federation.

There were resources that a number of teachers, and a couple of SAs, did not engage with because they were 'scared' of particular terminology or not confident in their own ability to effectively deliver the activities. For example, the Mission Starlight resource, which one teacher had not felt confident enough to explore, thinking that activities to do with 'radiation' would be difficult (viewing the front cover only - she flicked through it during the interview and found it more accessible than she had first thought). Other resources that teachers lacked confidence or the equipment to use include Astro Pi and the chemistry-related activities.

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Most schools we are going to there is no science specialist, or at least no one with a science degree. So I know going through the box there were a lot of schools that looked at it and go for the same stuff, the safe stuff, but they did use an awful lot of what was in the box.
(SA)

In addition, the starter kit was described by a number of teachers as a bit overwhelming at first. Where a member of staff (or a SA) had the time to go through the resources, and label them to make it easier for other teachers in the school to find activities that would feed into their curriculum needs, they were engaged with more effectively.

Whilst respondents were, in the main, very happy with the resources, the most frequently mentioned idea for improvement in the Y2 follow-up survey was to provide more resources for the early years, foundation stage and Year 1 pupils. One of the SAs interviewed filled this gap by developing his own resources focused on dinosaurs and space. Similarly, one respondent mentioned the limited choice of resources for pupils with special educational needs and disabilities (SEND).

I would like to see more practical resources and activities, which our special needs pupils need.
(Teacher)

A number of teachers agreed that they would have benefited from an index, or similar document that linked the different resources and/or specific activities to the relevant areas of the primary curriculum. They suggested that in an ideal world, this indexing could relate to colour coding within the resources themselves. This would also lend itself to increased use of the resources for cross-curricular teaching and learning: reducing the time required of teachers to explore the resources to find how they would fit into their subject area (especially when science topics are not as familiar to them) would encourage more to consider the use of space as a context for teaching.

In addition to the resources found in the box and the option to loan a Space Case, some SAs facilitated opportunities to loan space suits, moon rocks and meteorites as well as using resources they had developed.

Such resources included: Lego WeDo; View Master 3-D augmented reality viewers with apps that enabled tour of the space station; building Lego models of the space station and the Soyuz rocket; an inflatable planetarium; and other activities that could be easily integrated into theme of Tim Peake.

SAs also developed their own kits to help with the delivery of specific activities during their interventions in schools. A number of practical activities required resources that some schools were unable to purchase easily (e.g. a rocket launching pack). During one interview a teacher requested that local resource libraries be developed for use with future projects.

In addition, there were requests for more information about careers in space.

The careers booklet is quite thin. It had a couple of job profiles but it was limited... It was the Tim Peake project and it was all about him, but the reality is out of thousands we might get two astronauts...but we want hundreds and thousands of designers technical experts, scientists and I think that's where it could have been developed more.

(Teacher)

5.3 Provision of Space Ambassadors and CPD Delivery

SAs were rated as crucial or very important by 76% of survey respondents and teacher CPD was rated crucial or very important by 73%. The provision of CPD and access to the support of a SA were particularly important for around three quarters of the teachers interviewed. The implications for future projects are that these support structures should be maintained.

The space ambassador was amazing. She is just so inspirational and brought in lots of really good resources and the children really, really loved her. She was fab with them and her coming to do the CPD for us as well was really good for the teachers. It gave them a bit of confidence...It created a real buzz.

(Teacher)



The support given by the space ambassadors was phenomenal.

(Teacher)

My space ambassador was really quick to respond to any queries and to offer support if I needed it. She was encouraging and accommodated all requests of her time.

(Teacher)

One of the main benefits of having access to a SA was the novelty value that having a guest educator has on the engagement of the pupils. Although many of the teachers would have been able to deliver the activities included within the SA's interventions, the fact that an 'expert' had come in to talk to the pupils (especially those who wore mission boiler suits or had photographs with Tim Peake) meant that they were able to hold their attention much more effectively. There were other advantages to be gained, especially when SAs were women and/or shared other identity characteristics with the school community, providing important role models.

Having a female space ambassador who was enthusiastic and knowledgeable, and a Welsh woman, was an inspiration especially for the girls.

(Teacher)

The SAs were praised for generating interest in science and in STEM careers and for the knowledge they were able to share with pupils.

Having our Space Ambassador come and talk to the children was amazing. He had so much actual experience to share and could answer trickier questions with absolute certainty. He also inspired the children to consider STEM as a career - including less able children who have low self-confidence.

(Teacher)

In addition, a number of teachers in both the surveys and the interviews, talked about the SAs as being important sources of relevant information for them. As well as subject knowledge and details about the TPPP, this information included knowledge about places to visit in the local area as part of space/STEM education projects. Thus, the SAs had an important role to

play in primary teachers' professional development, particularly in relation to science education.

Two SAs interviewed developed a shortlist of activities that were deliverable in schools based on the amount of equipment that could be carried – especially with rural schools that were more difficult to reach. Restricting the number of activities was also an approach used by SAs responsible for a larger number of schools – giving teachers fewer choices of interventions delivered by their SA.

Challenging to have so many schools in terms of delivery of activities...especially in terms of the amount of kit that would be required to deliver everything that the schools wanted. So I limited the number of activities that were available to teachers. But you could be an expert in all those things [in the starter kit] and offer advice to teachers who chose to develop and deliver these activities.

(SA)

The number of schools each SA could manage depends very much on their available time. Therefore, a clear plan of expectations for working with a school should be developed, which includes estimated time required for preparation and related tasks, so that SAs can justify how they are able to fit a specific number of schools into their work schedules.

However, there were also pedagogical as well as practical reasons for limiting the number of activities offered, especially when the SAs had teaching experience and were better able to support the use of the resources in the starter kit.

With my teacher hat on, knowing what works in schools and what doesn't work in schools, when I did the CPD events I would say look at this one - I think this will work well or won't work so well or you can tweak it... the resources were variable so it was a case of use these ones, don't use these, and then adding some of my own ones accrued over the years as well.

(SA)

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With this in mind, for a number of SAs it was an important balance to deliver an intervention with pupils in schools, but also provide a learning opportunity for the teacher:

You've always got to be careful, the fact that you don't want to be seen as 'I can only do that when M is here or if I've got that specialist bit of kit' and when you walk away they say 'well I can't do that', so you've always got to work with what you can pick up in a local shop cheaply.
(SA)

This approach was mentioned by a number of SAs, emphasising the role of the SA in ensuring that CPD provided by the TPPP was a continual process, and not confined to the formal delivery sessions alone. The lessons to be learned had mixed responses from teachers, which could possibly relate to the SA's experience of interacting with young people – especially those from industry or higher education/academic backgrounds:

The way the space ambassador organised resources actually inspired me to go out and buy new boxes, new tabs, new timers, everything that she had I wanted so I made a list...and she organised things into crates to have like five crates for five tables...
(Teacher)

I did feel a bit like the activities delivered by the space ambassador was science by numbers. It felt very prescribed and very let's do this now, do this, do this, do this, which isn't really the way I tend to work with my class, but I understand that when you're coming in working with children that you don't know you have to be a lot more structured..
(Teacher)

The delivery model of the TPPP therefore worked well for most schools, but there were a minority of cases when it did not. For example, some schools chose not to engage with their SA after the CPD had been delivered – either because they had decided not to continue with the delivery of the TPPP, or because they felt confident enough to run the project without outside assistance. Those not using the resources were asked by some SAs to return their boxes, which were then redistributed to other schools. In one area of England, unforeseen circumstances meant that a

SA was not available for the schools signed up to the project. The teachers were therefore provided with CPD at a local observatory, and later provided with opportunities to take advantage of the facilities there with their pupils.

All respondents to the Y2 follow-up survey were either very satisfied or satisfied with the organisation of the project in general: 96% were very satisfied or satisfied with the responsiveness of the TPPP team; 96% with communications from TPPP; and 99% with the effectiveness of TPPP support to their schools. Teachers were thus very positive with the TPPP organisation and support.

Only six respondents of the 95 responding to the survey provided details of aspects of the project they were dissatisfied with. Of these, five respondents were not satisfied with the limited contact they had with the SA or ESERO-UK.

Perhaps a bit more checking in - great response if I had a question, but some active contact to see how things were going would be great.
(Teacher)

In being asked what could be improved about the management of the project, the most frequent improvements mentioned in interviews and survey responses was increasing the amount of time that schools had with their SA. This most often referred to benefits of having access to an SA, as the project had been so successful, rather than not getting enough time with them. Suggestions for improving teacher CPD in the survey responses included: more whole school training; follow up training/continued CPD/reminders; and specialist training (e.g. physics specialists, early years).

In addition, it is recommended that more training of SAs in the delivery of activities with pupils be developed, especially for SAs from non-teaching backgrounds with less experiences of engaging with young people.

5.4 Communication, Paperwork and Timing

Most of the negative comments made by SAs and teachers with regards to the management of the project referred to what they considered to be the administrative aspects of the TPPP. These included: the completion of paperwork and grant applications; engagement with the online community; the timings of the project and the ability to facilitate effective communication between SAs and teachers; and in a minority of cases between teachers and ESERO UK.

Shortly after their school joined the project, teachers were expected to complete an Action Plan that outlined what they intended to do. At the end of the year, they were asked to complete an Impact Survey, sharing their reflections on their participation. A number of the teachers interviewed were asked about their action plans and how useful it had been as a tool for planning. In general, they either could not remember filling one in or mentioned/provided the schemes of work they had developed detailing how the TPPP ran in their schools. Therefore, from these interviews it can be assumed that the action plans were seen mainly as a means of establishing accountability in terms of how they were using the resources that they were being provided with, rather than a tangible plan of action.

Given that the action plan included a list of suggestions that could be referred to when deciding what they intended to do, this document did offer a framework for teachers of the different ways in which the TPPP could be delivered, and potential outcomes of participating, which was useful for those who were unsure of how they would engage with the project. However, it is also possible to argue that this framework, or advice on how to deliver the TPPP, was provided by the SAs as well. It is not possible to ascertain how (un)effective the action plans were from the data generated as part of the evaluation. As the Action Plans were intended to facilitate implementation and sustainability, teachers and schools may need clearer guidance about their purpose and likely benefits as a planning tool.

As part of the project, teachers were asked to join a forum - the online community - on the TPPP website

where they could upload photographs and other evidence of their participation in the project. The online community was designed to provide a networking platform with which teachers could share their ideas and activities with each other. Of the teachers and SAs interviewed, very few referred to it as useful for networking. Online communities are notoriously difficult to establish in educational contexts mainly due to competing demands on teachers' time. The potential benefits need to be clearly identified to teachers from the outset and regular reminders to participate can be helpful. The chosen platform itself can be a barrier to uptake. In this evaluation, teachers' and SAs' attitudes towards online platforms and social media were mentioned as reasons for not engaging with the online platform. For example, some teachers chose to share what they were doing through other means: Twitter, Facebook, school newsletters and local media (including newspapers and local radio). Therefore, it may be worth adopting a platform that is in common and widespread use (e.g. social media networks such as Facebook or Twitter). This needs to be reviewed regularly as such tools come and go.

In describing the difficulty of getting teachers to engage with the online platform, and in some cases how the online platform was evidence that they had engaged with schools and therefore could provide proof for payment, the SAs gave the impression that the platform was an accountability tool, rather than a networking platform.

I don't think many of the schools, even the enthusiastic ones, filled in all the paperwork or responded to the review.
(SA)

The online community was one of the hardest things to actually get done. It was an absolute nightmare constantly emailing teachers and trying to encourage them.
(SA)

...I wasn't quite hot enough on getting them to upload the evidence, and felt a little bit like I failed in that respect in the first year. But in the second year my schools were always uploading so I'd already taken that on board and I really pushed that message out. So management in the second year was better.
(SA)

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Often reference to the online platform was made alongside the difficulty of completing administrative tasks, such as the paperwork described above, which again suggests that it was not always seen as a networking platform or useful for teachers to engage with.

Having to juggle the forms, questionnaires, spreadsheets, and uploading information to the online communities can be a lot.

(Teacher)

Only 40% of respondents in the Y2 follow-up survey rated the online community as crucial or very important, and those teachers interviewed that did engage with it for networking had mixed reviews about what it had to offer.

What I had to share was not as impressive as others' posts. You know people were saying oh such and such coming from industry for the day and done X and I was like I have no idea if we have any people like that round here...I don't think I got any new ideas, it basically showed me things that I wasn't doing that I couldn't do.

(Teacher)

As an aside to the evaluation of how the online community was promoted, this above quote came from a teacher in a rural setting who did not have access to outside expertise, beyond the SA, such as universities, science/space centres and industries that they could invite into the school or visit as part of the programme. Therefore, suggesting the need for networks of such possibilities to be developed that enable access for schools that are more difficult to reach.

One of the problems voiced by all the interviewees was the extent to which administrative tasks, and engagement with the online community, added to teachers' already extensive workloads, especially when deadlines to submit information coincided with other key moments in the school year such as SATs.

...they're all under huge amount pressure for everything else, teaching, administration, dealing with parents, difficult children, it's all a balancing act.

(SA)

In a number of cases, the science coordinator was the only one uploading such information, often because she/he did not want to add to others' workloads, which could be extra time-consuming when they ran whole school programmes of activities – more than one science coordinator mentioned spending time of the half term or Easter breaks to do this.

In the first year of the project, 854 action plans were completed, but only 453 teachers responded to the impact survey (54%). In addition, only 41% of respondents to the Y1 follow-up survey (n=51) said they had uploaded resources to the Online Community Group. Lack of time was the most common reason given for not doing so (43% of those giving a reason), which was followed by lack of awareness (22%). It is difficult to address teachers' lack of time although this is more a matter of prioritising what can be done. Providing clearer guidance about the purpose and benefits of the online community could address the lack of awareness and encourage teachers to prioritise its use. A small number (3%) had problems uploading resources. In some cases (2%), respondents felt that the site could be made easier to navigate, but in others, it was technology within the school that prevented them using the group effectively, for example:

Poor computing hardware at work.

(Survey Response)

Online uploading of evidence was slow and time consuming. Not straight forward.

(Survey Response)

A number of the SA took the time to assist schools with completing forms and uploading evidence onto the online community to help with the workload. In the main, this was because they interpreted the online community partially as a means of accountability of their interactions with the schools, or as a way of documenting evidence towards a Space Education Quality Mark, suggesting that the way in which the online community is promoted and accessed should be revisited.

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In general, communicating with schools was one of the biggest hurdles that SAs faced, which again was explained by the heavy workload that primary school teachers face on a day-to-day basis. Whilst some schools were enthusiastic and proactive, others forgot they had even signed up to the project and did not understand its requirements.

Managing the different level of expectations and the different levels of engagement could be quite fraught especially when deadlines were looming..

(SA)

The timings, such as the interval between a school registering for the project and being notified of being accepted, and the time between this notification and having to start their projects was also an issue – especially when teachers need time to plan and budget for the coming year.

Very slow starting both years, by the time you get the yes you can go ahead...Needed a couple months more notice in the schools earlier, before the teachers have done the planning what they were doing and budgeting.

(SA)

Other concerns raised by SAs, were outdated email addresses, because teachers had moved schools, or the project abruptly coming to an end, or not happening, when the teacher involved went on maternity leave. This is a common feature of educational projects. It can be addressed through providing clearer guidance to SAs and schools on how to deal with such situations when they arise (e.g. establishing a process for formally notifying the SA, identifying succession procedures in Action Plans).

All of the SAs interviewed felt that they were effectively supported and recommendations with regards to their communications with ESERO-UK were mainly concerned with receiving timely information about events, such as the UKSA competition.



- What did I find out today? I've learned about space. We learned that 2 liquids make fire. We watched a video of Tim Peake being chased by a gorilla. (Literacy activity at Sherborne Preparatory School)

“We felt that we had more of a connection with Tim Peake than anyone else did because we were part of the project so if the children saw him on the news or the telly they’d be straight in to tell us about it because we know him! It was something that we were involved in, we felt proud to be involved in it really.”

(School Science Coordinator)

This evaluation of the delivery of the TPPP focused on the outcomes described by STEM Learning’s Model of Change (MoC), shown in Figure 1 - using a combination of qualitative and quantitative methods to address two key objectives.

- Assess the longer-term impact of schools’ engagement in the programme on teachers, pupils and schools, particularly to what extent the short-term impact (as presented in the interim evaluation) has been sustained.
- Assess the efficiency of the project delivery model and provide recommendations on how to improve management, delivery and impact of the programme, especially if adopted for other similar projects or programmes.

The following sections address each of these objectives in turn.

6.1 Long-term impact of schools’ engagement in the TPPP

As outlined in the interim evaluation, participating in the TPPP increased pupils’ engagement, interest, and enjoyment in STEM subjects. Using space as a context for teaching captured their imagination, providing an opportunity for teachers to better engage young people with science education. In particular, the project was able to increase the engagement of groups of young people who would otherwise not usually engage: e.g. girls or young people who were usually passive, or had specific learning needs that made participation difficult. The impact of the TPPP on young people’s engagement in STEM continues to be sustained, especially in schools that continue to utilise the resources provided for use in delivering the project. The increased engagement of their pupils was

a key motivation for teachers’ embedding their use of the resources into the delivery of the curriculum.

Given the increase in engagement of young people in STEM, future projects should identify opportunities to build on key science events to maximise opportunities for enhancing engagement, particularly those related to space and those involving role models that young people in the UK can identify with.

The interim evaluation reported that the TPPP increased attainment of young people in STEM subjects. It was difficult to assess the degree to which this impact has been sustained as most teachers interviewed felt unable to assess the lasting impact of the project. Only one was able to quantify an increase in attainment, suggesting that the impact of the TPPP has been sustained to some extent in the year that followed the project. It is recommended that the CPD provided in future projects include a focus on measuring the impact on attainment, as an understanding of this impact would be useful evidence to inform teachers’ pedagogical approaches as well as informing the delivery of projects developed by ESERO-UK and STEM Learning.

The TPPP had a positive effect on outcomes in terms of young people’s aspirations, increased knowledge of STEM careers, and the development of skills such as working in a team, communication and problem solving. Teachers were most enthusiastic about the impact of the project on the uptake of STEM subjects and STEM careers in the interim evaluation. As less than half of teachers responding to the follow-up surveys remained convinced that the impact was sustained, it is recommended that primary schools be encouraged to embed resources, such as those provided by the TPPP, to continually provide young people with experiences that raise and sustain awareness of the importance of science and STEM career possibilities.

The TPPP increased teachers' subject knowledge and pedagogical understanding, providing CPD and resources for teaching about space and alternative ways of delivering the primary science curriculum. In particular, teachers' confidence in delivering practical activities or engaging in enquiry-based learning has been positively affected, as well as their confidence, motivation and enthusiasm for teaching space topics and using space as a cross-curricular context for teaching and learning. Building on teachers' previous skills and experience to develop confidence in their own abilities, involvement in the TPPP has developed their capacity to embed programme activities in a creative way – for example, being able to modify the activities to bring in additional dimensions to support enquiry-based learning and collaboration between colleagues. All of which have been instrumental in helping some schools meet external pressures, such as performing for OFSTED inspections or meeting the standards described by the Donaldson report.

This impact of the TPPP goes beyond the use of space as a context for teaching, in that there are instances of teachers' increased use of other authentic contexts within which to meet curriculum goals (such as a cross-curricular exploration of coral reefs or registering to participate in the Polar Exploration Programme). Although, sustainable long-term impact of the TPPP on teachers and schools is mainly evident in the continued use of resources provided in the starter kit and teachers' increased confidence in developing their own resources for use in teaching with or about space. These resources have been embedded into schemes of work in science and other subjects across the curriculum, used to develop extra-curricular programmes such as science clubs, and in outreach work with other schools and wider communities by teachers and SAs. The resources are therefore reaching young people and schools who did not directly participate in the TPPP.

However, every SA interviewed talked about how it could be a challenge to encourage the involvement of some schools and/or other staff members in the project, or taking it beyond a minimum delivery of applying some resources to the Earth and Space unit. When head teachers, members of governing bodies or senior management teams were engaged and supportive, or

were the initial staff member registering for the project, the TPPP tended to be delivered more successfully, often via whole school programmes that had a greater long-term impact on the schools involved. Schools who were using their planning of the TPPP to work towards a Space Education Quality Mark also delivered more comprehensive cross-curricular programmes.

Schools that continue to engage with the TPPP resources, are:

- organising regular space days/weeks;
- registering for other STEM-related initiatives to engage specific groups of learners (such as girls or gifted and talented students) or providing a whole school focus similar to the TPPP;
- and recruiting a science coordinator where previously there was none.

The enthusiasm of teachers for the continued use of space as a context for teaching in schools stems from the positive educational outcomes for pupils. Pupils' increased engagement was more evidently sustained in schools that had continued to use space as a context for teaching, had changed their approach to teaching and learning in science, or who have registered for other STEM or whole-school programmes.

The interim evaluation did not report on the impact of the TPPP on SAs and the wider community in which schools operate, therefore the following discussion explains these additional areas of impact. The TPPP has had a positive impact on SAs, enabling their access to a greater number of schools – both participating in the TPPP and others who became aware of SAs' education outreach activities because of the TPPP. SAs received training as part of their induction to the TPPP and access to resources provided in the starter kit. In combination with the equipment they developed to deliver the activities described in the resources and resources of their own that enhanced their delivery of the TPPP, they have developed a bank of resources for use in future work with schools and other STEM projects.

SAs have also been able to develop contacts within the STEM community, which has had a positive impact on the education projects they develop, their local and national exposure, and consequently career progression. In providing opportunities for networking between SAs, the TPPP encouraged the sharing of good practice and the development of groups of critical friends with whom they could discuss aspects of the project. These networks continue to be useful to SAs who continue to work for ESA, UKSA or volunteer their expertise as STEM Ambassadors through their work in industry/academia. Other SAs are now able to use these networks to develop partnerships for new projects, collaboratively apply for funding, and further increase the profile of STEM subjects locally and nationally.

The reach of the TPPP also extends to parents, grandparents and members of the local community who directly and indirectly engaged in the TPPP. Given that there is a focus on getting parents to engage more with schools and their children's learning, to improve educational outcomes for young people, future projects could provide more opportunities for their participation – either through the development of more extra-curricular activities, or encouraging parents to come into schools to get involved.

6.2 The efficiency of the project delivery model

The findings indicate that participants in the evaluation process generally viewed ESERO-UK's management of the TPPP to be very effective. Space Ambassadors (SA) were happy with the training received and the autonomy they were given in terms of how they facilitated the support provided to schools. Schools were generally happy with the support received and the organisation of the project, which was predominantly down to their relationships with SAs.

SAs were a crucial aspect of the TPPP: they were important sources of information related to teaching science and space, and a local point of contact who could encourage involvement in, or visits to, local STEM initiatives, and a critical friend who was instrumental

in increasing teacher confidence and subject knowledge in space topics. How the TPPP was managed in schools, and the range of activities they had access to, depended to a large extent on how each SA performed their role.

The CPD provided by SAs helped teachers to navigate the resources provided in the starter kit and to plan how they would deliver the TPPP in their schools. When the CPD was provided to at least half of the teachers in a school, it was more likely to result in programmes of activities that involved the whole school, which had greater longer-term impact on pupil and teacher outcomes. CPD delivered to one or two members of staff from multiple schools attending a shared session could encourage active networking between local schools participating in the TPPP. Although this CPD was mainly described as extremely useful, there were teachers who felt that additional CPD would have been useful. Therefore, CPD provided by a series of webinars, such as models used in Scotland, could be effectively used as follow-up training to further develop teachers' scientific knowledge, and their ICT skills. However, connectivity is an issue in more remote areas – therefore recordings and the means to work offline on these units (maybe using mobile phone-based applications) would be useful.

The resources provided by the TPPP were identified as the most important aspect of the project, described as high quality, professional, and effective: teachers could pick many of them up and apply them with little extra work. The pack as a whole could be overwhelming for those that lacked confidence initially in their abilities to deliver the TPPP (which is where the SA's input is useful) and so it is recommended that similar resource packs, developed for future projects, be equipped with an index outlining the relevance of different resources. For example, providing a crib sheet that links each resource/activity to the various sections of the primary school curriculum where they are most applicable.

The main area of improvement to the management of the project in schools, suggested by teachers, concerned increasing SAs time in schools – usually because SAs were engaging and effective.

Teachers' responses to the TPPP online community, developed to encourage them to share their experiences of the TPPP, varied. Those who did not engage with the community cited their inability to find the time as the main reason for not engaging. Other reasons included difficulty of navigating the system, age and ICT/social media fluency. Lack of time was also an issue when applying for grants by specific deadlines and filling in paperwork required as part of their involvement in the TPPP.

In summary, the TPPP was a well-managed project that had a positive impact on pupils' enjoyment, engagement and attainment in science and, to some extent, in other areas of the curriculum too. It also helped to improve teacher confidence in teaching space topics and raised the profile of science in schools. Over the longer term, this impact has been sustained in schools that have continued to use the TPPP resources. The use of authentic contexts, such as space, as a context for learning has also increased and schools have registered for other projects, similar to the TPPP. The impact of the TPPP extends beyond schools registered for the project: networking between schools has increased as well as schools' community engagement.



► Analysing Martian soils at Damer's First School

“Only negative to the project was wanting to do a lot more and not having the time to do it.”

(Teacher)

The evidence suggests that the TPPP was beneficial for increasing teachers’ confidence for delivering STEM activities and engaging young people’s interest in STEM learning activities. Therefore, the following recommendations apply:

The TPPP provided an effective management model that should be replicated for use in other, particularly STEM-related, education programmes.

Future projects should use the TPPP resources as a model of excellence (given the positive feedback received) but also take account of the specific pointers below on how resource provision could be improved further.

Roll out the TPPP again in future, particularly if Tim Peake returns to the ISS.

Cross-curricular context-based teaching could be applied effectively across other key stages, at secondary level, to provide a real-world context for the skills and knowledge taught.

Identify opportunities to build on key science events to maximise opportunities for enhancing engagement with future projects, particularly those related to space and those involving role models that young people in the UK can identify with.

Establish the means for rural schools, or those in urban areas with fewer university or industrial links, to access other resources and events to enrich their engagement in similar projects or delivery of STEM subjects.

To ensure that similar projects achieve and build upon the impact of the TPPP, recommendations include:

Engaging head teachers should be considered as a first step to engaging with schools.

First contact with schools, made by SAs after their initial registration, should be as early as possible to provide enough time to plan and prepare for the delivery of the project.

Encouraging schools to develop an embedded cross-curriculum approach to the delivery of the TPPP and providing guidance on how the resources fit into different areas of the primary school curriculum. In particular, such guidance should highlight and prioritise the role of TPPP activities in meeting literacy and numeracy targets.

Providing goals for schools at the outset, such as achieving the Space Education Quality Mark, could provide incentives for engaging with the project and sharing their learning.

The CPD provided in future projects should include a focus on measuring the impact on attainment, as an understanding of this impact would be useful evidence to inform teachers’ pedagogical approaches as well as informing future project delivery.

Provide online CPD provision that extends the CPD provided by SAs – providing options to catch up with recordings of webinars and options to work offline in areas with limited connectivity.

Making schools aware of the role of the TPPP and similar projects in addressing the gender gap in STEM qualification take-up and STEM careers and continuing interests in inclusive education. Additional guidance and exemplars of good practice for teachers would be beneficial.

Provide more ‘take home’ resources for pupils (with links to online resources) and extra-curricular opportunities for young people and parents to engage with the project.

Primary schools should be encouraged to continually provide young people with experiences such as the TPPP that raise awareness of the importance of science and STEM career possibilities, and that this awareness is sustained.

In addition to the above, the following recommendations were suggested by teachers and SAs interviewed as part of the evaluation:

Funding the development of a small number of schools across the UK, e.g. 100 schools who were more actively engaged in the TPPP, to make them beacon schools of the project who would continue to integrate space into their programmes of work and could share their experiences with other schools in the area.

Rolling out the TPPP again in the future, particularly if Tim Peake returns to the ISS - slightly tweaking resources that are perfectly valid to be used again. The advantage is that many teachers who were involved in the TPPP but have since moved schools would want to engage.

In addition to repeating the TPPP, it should be expanded to include Key Stage 3 - particularly year 9 who are thinking about future careers and choosing GCSE subject options. This would also build on the impact of the TPPP, in that the pupils who participated will be in secondary school if he does return to the ISS.

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