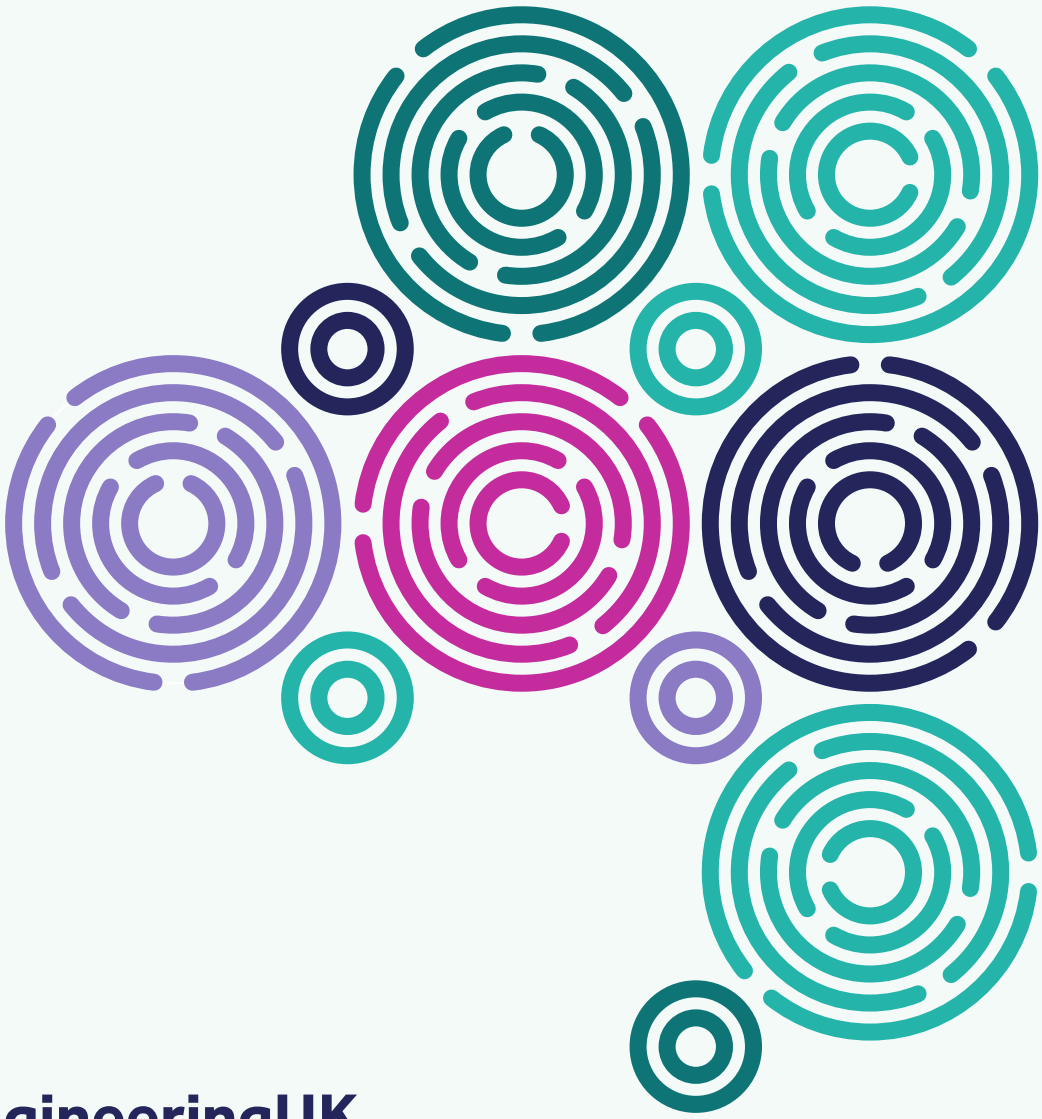
LESSONS LEARNED FROM ENGINEERINGUK PROGRAMME EVALUATIONS

Teacher-led delivery approaches



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Summary

EngineeringUK runs a range of STEM outreach programmes and activities for schools across the UK to support its mission of inspiring, informing, and helping young people from all backgrounds progress into engineering and technology careers. In this thematic review, we share lessons learned from our teacher-led activities (such as Energy Quest and the Climate Schools Programme, both of which offer curriculum-linked content for teachers to deliver during lesson time). In this report, 'teacher-led' is contrasted with 'facilitator-led' provision.

Key learnings and recommendations include:

- the role of teachers varied greatly, from delivering downloaded resources to leading and managing projects in collaboration with outreach staff
- teachers decided whether to participate based on their judgement of the teaching and learning resources, clarity on where to fit into school schedules and, sometimes, permission from senior colleagues. The main challenges to increase uptake were a lack of finance and time in busy school schedules and, in some cases, teachers' confidence to pick up a lesson and run with it
- the main factors for success were as follows:
    - offering content that teachers are less familiar with, such as solutions to climate change or the range of engineering and technology careers available, helped teachers expand what they present to their students
    - activities that offer students more opportunities for developing employability skills, such as problem-solving, were particularly appreciated by teachers
- high-quality, adaptable learning materials accompanied by concise teacher guidance, which brings teachers vital time-efficiency

Introduction and method

EngineeringUK is a not-for-profit that drives change so more young people choose engineering and technology careers. We work in partnership with hundreds of organisations, all of which share in our vision for a UK with the diverse workforce needed for engineering and technology to thrive and to drive economic prosperity, improve sustainability and achieve net zero.

EngineeringUK runs a range of STEM outreach programmes and activities for schools across the UK to support its mission of inspiring, informing, and helping young people from all backgrounds progress into engineering and technology careers. We recognise that students need to engage with the wider STEM curriculum to progress into engineering and technology careers, hence some of our activities are broader than just engineering and technology and focus on STEM.

This thematic review brings together evidence from the evaluations of our teacher-led activities in the last 3 years, with additional input from relevant programme leaders. The aim of the paper is to

inform continuous improvement and be able to share lessons learned for programme design with the wider STEM outreach community.

We start by defining what we mean by a 'teacher-led' approach and how our programmes and activities fit into this definition. Next, we summarise findings around why teachers and educators decided to participate in our programmes, and what content, structure and support worked well for them. After outlining the barriers and challenges presented by teacher-led approaches, we reflect on what these mean for improving programme design and delivery.

This paper was compiled from systematically identifying relevant extracts from 4 of EngineeringUK's evaluations and some additional raw data from the last 3 years. Themes were conferred with a second researcher, and we ran a focus group with EngineeringUK colleagues responsible for developing and delivering our activities. Some of the evaluation reports are not published externally. We've linked to published reports where possible and have made it clear when we're referencing unpublished reports. For more information on our internal evaluations, please contact evaluation@engineeringuk.com.

What do we mean by teacher-led delivery?

In the outreach sector, teacher-led delivery approaches are often contrasted with 'facilitator-led delivery approaches'[1], which are relatively easy to define. Facilitator-led approaches typically refer to an external organisation or individual visiting or hosting school students and delivering content to them. Teacher-led approaches however include a variety of options with varying degrees of autonomy for the teacher. For example, the teacher-led approaches developed by EngineeringUK in the last 3 years, most notably, Energy Quest in 2024 and the Climate Schools Programme were designed so that teachers could register online, download the materials and independently deliver a fully pre-prepared lesson or workshop. In contrast, other programmes and activities are also teacher-led, but in different ways and to different extents. For example, Big Bang at School events are organised by delivery partners, with delivery by a mixture of school staff and external facilitators, while Big Bang Blueprint is a roadmap for schools to run their own Big Bang event while receiving various forms of support from external partners. Despite there being a variety of ways to deliver a teacher-led programme or activity, the main benefit of this approach is extending an organisation's reach, as it allows more young people to get involved with the content than would be allowed by more costly facilitator-led approaches.

Thus, EngineeringUK's definition of teacher-led approaches is broad, ranging from fully prepared teaching and learning materials to teacher involvement in planning and direct delivery to students (see Table 1 for a summary).

[1] Note that in the education sector, the term 'teacher-led' is typically used in contrast with 'student-led approaches' to teaching and learning.

Table 1: Summary of EngineeringUK's teacher-led programmes and activities

Type of teacher-led approach	Programme or activity	Summary
Teachers download and deliver subject lesson(s)	Climate Schools Programme	EngineeringUK developed ready-to-use lesson plans and resources for science, English and geography subjects. Educators download and deliver in lesson time without further external support. One of this activity's goals is that, by directly delivering the lesson themselves, teachers will see the relevance and benefits of the content to their teaching goals and students' needs and therefore continue to use it with more students in future.
Teachers download and deliver a science lesson/workshop	Energy Quest (2024 iteration)	EngineeringUK developed materials and resources for science teachers to select, resource, adapt and deliver in lesson-time without further external support. Educators download materials for science teachers to deliver in lesson time.
Schools host, manage and co-deliver an off-curriculum event, with an external facilitator	Big Bang at School	EngineeringUK coordinates schools and delivery partners for schools to run off-curriculum events. Schools co-design and manage the events alongside the external partners, often with members of school staff delivering some activities. EngineeringUK bursaries are available to support this programme.
School staff design and deliver a careers or STEM curriculum-linked	Big Bang Blueprint	EngineeringUK developed planning resources for in-school STEM activity or careers events. Schools plan and organise an event typically lasting half a day or a day, delivered by a mix of teachers and invited STEM providers and employers.

It should also be noted that within each evaluation, we used similar survey and interview questions, but wording differed slightly depending on an activity's specific outcomes. For example, some activities cover STEM more broadly, so survey items used science, engineering and technology in their phrasing, while others were more specific to engineering and/or technology. To ensure we are not generalising, we have specified which word (engineering, technology or STEM) has been used throughout the report.

It is worth noting here that EngineeringUK's The Big Bang Fair and Tomorrow's Engineers Week do not currently involve teacher-led delivery and so are beyond the scope of this paper. Further, Robotics Challenge and Climate Action Club are extra-curricular clubs so were omitted from this report because these will be the subject of a future thematic report on clubs.

What motivated teachers to engage with EngineeringUK's teacher-led programmes and activities?

High take-up by teachers is key to the success of teacher-led programmes and activities, as is reflected in reach targets set for each one. The evidence gathered in our programme and activity evaluations indicates that teachers participated because of:

- the high-quality of the materials, including fully developed teaching and learning resources
- how clear the information was about the activity meeting teachers' and students' needs and fitting into school timetables
- initial awareness raising by EngineeringUK, mainly through advertorials
- their cost, as the decision to participate is much easier if it requires no or minimal budget
- how easy they are to access online
- having had a positive previous experience with other EngineeringUK programmes and activities

Teachers described how they searched online for inspiration on a particular curriculum topic or skill that they believed students should cover in more depth, a point that was also emphasised by programme and activity leads at EngineeringUK.

Ease of registration was important. One Climate School Programme participant described the wider process of accessing this lesson as...

"...really easy to sign up for. It wasn't like 'you have to do this to get this'. You could just pick and choose what bits worked for you. That was a massive incentive". Teacher interview from Climate Schools Progamme evaluation [2]

For some teachers, their main reason for taking part was that they had had a positive previous experience of the same or a different EngineeringUK programme or activity. For example, many had attended The Big Bang Fair and were therefore on the list to receive emails about other programmes and activities. Note that teachers who delivered the same programme or activity previously may or may not re-access the website to find any updated materials.

[2] Climate School Programme 2023/24 final evaluation findings, 2024. Unpublished.

What factors helped teacher-led delivery work well?

Across the individual programme and activity evaluations, there were clear enablers in terms of what helped teachers successfully use the teacher-led resources. They emphasised in particular that the resources:

- were high-quality and concise
- took them beyond their current knowledge and contextualised curriculum content
- flexible and adaptable to their own context
- received well in advance, making the timing of things easier
- freely available and low cost to deliver

Teachers noted that the high-quality and concise teacher guidance documents and ready-to-use learning resources were key to allowing them to plan and effectively deliver the programme or activity. For example, teachers who delivered the Climate Schools Programme appreciated the quality and clarity of planning materials:

"I liked the structure and [the] information given. It made everything accessible for all types of learners." Teacher interview from Climate School Programme evaluation

Teachers are time-poor and did not want to spend a lot of time preparing materials for teaching. For example, one teacher praised Energy Quest for its high-quality guidance and resources that could be delivered "almost off the peg".

At the same time, they wanted to avoid 'reinventing the wheel,' drawing on others' work and knowledge. Indeed, we found that teachers looked to STEM outreach organisations to take them beyond their existing knowledge and resource bank, which usually meant content that contextualised students' theoretical learning and provided up-to-date careers information. Teachers greatly appreciated resources and materials that were fully developed.

Fully developed materials did not, however, mean that they should be inflexible. Evidence from EngineeringUK strongly suggests that teachers prioritised being able to tailor the content provided to meet the needs of their students and school. Indeed, all Climate Schools Programme and Energy Quest lessons that were observed in 2023/24 were adapted from the original in terms of content covered and the order of slides and activities.[3] Almost always, this was to fit the lesson into available time by cutting some content.

Teachers also added starter activities used throughout their school or supplemented the lesson plan provided with their own knowledge and experience. Some teachers made links with recent

[3] Final internal CSP evaluation 23-24 findings, EngineeringUK, 2024 and Energy Quest teacher-led 2023-24, EngineeringUK, 2024. Unpublished.

lessons or omitted activities that students had already done, which are limitations of facilitator-led delivery. If delivered as part of off-curriculum learning at the end of summer term, some teachers continued the lesson over the next 2 or 3 lessons because they had time and the first had been a success, which wouldn't be possible for facilitators. Since the pilot of the Climate Schools Programme, the amount of content has been slimmed down to a fast-paced 55-minute lesson. Energy Quest has also been revised over time in response to feedback and could move towards a 'menu' approach comprising core and optional activities.

In addition to lesson length, there were other aspects of timing and scheduling that were important for teachers. What worked well for Energy Quest was for teachers to receive any equipment and physical resources well in advance of delivery to enable them to make any required modifications.[4] For both Energy Quest and the Climate Schools Programme, teachers found that re-teaching certain topics just beforehand was a good way to help all students get the most out of the lessons. For example, reminding students what crude oil is or how electricity is generated.[5]

While discussing what worked well, teachers noted what additional support they would welcome beyond teaching and learning materials. For programmes and activities that can involve coordinating lessons across multiple subjects, like the Climate Schools Programme, teachers recommended sending communications to a specific contact such as the STEM Lead or Climate Action lead. This would help keep all the relevant information in one place and simplify the process. These communications should not only highlight time-efficiency and quality of expert-made resources but also how programmes and activities could help them towards Gatsby Benchmarks, other Ofsted requirements and other initiatives such as Green Flag and Science Week.[6]

EngineeringUK's evaluations have gathered tips and support welcomed by teachers taking the lead on off-curriculum events. For example, a secondary school that is now experienced at running Big Bang at Schools has learned to:

- prioritise building working relationships with potential local delivery partners
- extend the reach to feeder primary schools
- offset the additional workload that organising such an event brings by distributing it across the academic year and, if possible, different members of staff
- start seeking financial assistance early on, as this takes time to secure.[7]

Finally, in terms of cost, one of the main issues of the alternative, facilitator-led approach is that there is a limited supply of high-quality external facilitators, and this often makes the expense too

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[4] Energy Quest Year 3 report, 2023. Unpublished

[5] Final internal CSP evaluation 23-24, 2024.Unpublished

[6] Final internal CSP evaluation 23-24, 2024. Unpublished.

- [7] BBS Blueprint Case Studies, 2023. Unpublished.

great for most state schools' budgets. Therefore, wherever possible, EngineeringUK seeks to fully fund or part-subsidise our facilitator-led delivery through bursaries.

Evaluations have found that bursaries enable participation from schools that say they would not otherwise have been able to take part in STEM outreach, or they are spent to enhance the quality of provision by paying for STEM experiences that would have otherwise been unaffordable. For example, one teacher said,

> **"The bursary money paid for the majority of the cost of bringing a workshop to school during our Enrichment week. Affording transport to go anywhere is difficult, so it's often better for us to bring experiences into school. These are often too expensive to fund without financial help."** Teacher feedback during Bursary evaluation

Our facilitator-led approaches have set reach targets, specifying the number of schools, total number of engagements and number of students each programme or activity will reach over the course of the year. We also set targets in terms of how many of these schools meet our priority schools criteria to ensure that our programmes and activities are delivered to students underrepresented in STEM careers. By contrast, the reach achieved by teacher-led programmes and activities is unknown and can be very variable. For our own teacher-led activities, we still set our reach targets in terms of number of schools and young people they reach, but our calculations are based on how many users register for and download our resources. Our registration form asks users which school they are from (so we can check how many individual schools are reached) and for more information about who they plan to deliver the content to (for example, the number of students, their year group and demographic characteristics).

Student outcomes in teacher-led delivery approaches

Teacher-led delivery approaches were rated highly by students and teachers in terms of the amount of knowledge students gained. For example, 72% of students said that the Energy Quest lesson had shown them the types of things that engineers do.[8] Teachers were similarly positive about the Climate Schools Programme, noting that it:

- engaged students because they could see career paths that they would be able to follow in their future
- gave students the opportunity to learn about something they would not normally learn about
- helped students gain more context around the subjects and how these link with careers

Having participated in Energy Quest, roughly one quarter of students were inspired to do more STEM activities and learn more about STEM careers. Teachers and students enjoyed Energy Quest and especially liked the problem-solving aspect. Overall, this activity succeeded in raising

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- [8] Energy Quest evaluation infographic 2023/24

awareness of the breadth of engineering careers and gave students the opportunity to develop skills relevant to engineering and wider STEM careers. Teachers delivering Energy Quest and Climate Schools Programme have attributed these positive outcomes to EngineeringUK's high quality materials delivered by someone that the students know well and trust.

However, while these programme and activity evaluations concluded that they were a valuable step in making engineering careers a possibility, additional efforts may be required to transform skills knowledge of STEM careers into genuine aspiration.[9] There is potential to continue these efforts through teachers, as they embed the content into current practice. For example, teachers trialling a new EngineeringUK lesson or event said that after doing it with one or two classes, they planned on:

- integrating it into future schemes of work
- making it the basis of off-curriculum 'drop down' days
- using elements for clubs, careers sessions and/or tutor time

In the Climate Schools Programme, 19 out of 21 teachers said they would deliver it again, though 14 of these teachers would make a few changes to how they do it. Further, 57% of teachers surveyed said they intended to ask other teachers in their department to also deliver the activity and a further 19% had already taken this step.[10]

Taken together, these findings support teacher-led initiatives leading to extended reach and sustained engagement through repeat delivery at the school level.

What are the challenges to delivering successful teacher-led programmes?

While teachers appreciated the quality and flexibility of programme and activity content, our review revealed many challenges including:

- a lack of consensus on the 'right time' to approach teachers and time constraints
- varying degrees of confidence amongst teachers delivering the content
- some teachers preferring facilitators to deliver content to make it more memorable and to share their knowledge and skills
- variability in which content is presented in the lesson or at the event
- obtaining approval from Heads of Department and Senior Leadership Teams (SLTs)

- [9] Energy Quest prepost evaluation 2022/23, 2024.

[10] Climate Schools Programme evaluation infographic 2023/24

Timing

While providing teachers with ready-made, high-quality materials reduced the time burden on them to develop this content for their students, there were other issues related to timing that teachers described, including meeting application deadlines and when the 'right time' to get started is in their school.

For example, EngineeringUK's Big Bang at School bursaries and The Big Bang Competition have annual application deadlines and teachers emphasised that they needed a fair amount of notice to be able to participate in these programmes. Although the amount of notice and preferred time of year for activities varied from school to school, all teachers we talked to needed time to fit programmes and activities into their planning cycles, to get managerial approval, for collaboration between colleagues and to secure any budget/funding required. For example, for the Climate Schools Programme, different teachers said they wanted to be notified by Easter, by May for first delivery in the following Autumn term and by June or July for immediate off-curriculum delivery at the end of Summer Term.[11]

Teacher confidence

Teachers noted that the quality of teacher-led delivery is highly dependent on the teacher's confidence and experience, as not all will feel comfortable picking up a lesson and running with it. These kinds of programmes and activities worked well for teachers who were experienced and felt confident to try something new. What worked well in some schools was having the Head of Department trial Energy Quest before rolling it out.

Building on the ideas of teacher confidence and their keenness to extend their knowledge, approaches that encouraged reflection and observation may be particularly successful. Our evaluation of the Climate Schools Programme showed that participation supported teachers' reflective practice and other forms of professional development. For example, as one teacher noted:

> **"… I think it's done us good to look at different resources and look at different ways of delivering it ... helping us reflect on our own practice... particularly around such a big issue that we're all passionate about and all want to teach appropriately."** Teacher interview from Climate Schools Programme evaluation.

Indeed, as we have already seen, not all teachers feel confident and competent to deliver new lesson content with teacher guidance documents alone. In 2025, Energy Quest introduced a professional development session to the activity as a condition of free delivery to classes; we look forward to seeing how many teachers can participate in this aspect.

For Big Bang at Schools events, the issue of confidence and competence is accentuated. A small number of teachers are relied upon to not only co-deliver events but also plan, coordinate external

[11] Final internal CSP evaluation 23-24, 2024. Unpublished.

organisations, arrange internal off-timetable schedules and select and adapt content to fit their students' and school's needs. This is why we offer a wide range of support, some directly from our staff, but also indirectly by supplying teachers with lists of local suppliers of free equipment and experiences, as well as encouraging them to go to other Big Bang events to help with planning their own event.[12]

Preference for facilitator-led approaches

Beyond confidence, our evaluation showed that some teachers would prefer to have content delivered by a facilitator. For example, of the 59 teachers surveyed after a facilitator delivered Energy Quest to their classes in 2023, over a quarter (28%) said that they would prefer not to deliver the content themselves.

One of the strongest reasons why staff and students appreciated facilitators leading lessons and events in schools was that having a visitor was out of the ordinary and therefore memorable. As one teacher said,

"Having external providers in school adds a different dynamic and excitement to STEM events", and another told us, **"Part of doing a workshop is having someone different into school" and another said, "I have run the workshop without an external facilitator, and it is the novelty of the visitor that raises the standard of the workshop."** Teacher interviews from Energy Quest evaluation

Further, effective facilitators bring their expert knowledge into schools. This appears to be the case whether the facilitator came from an industry or education background**.**

Many teachers praised facilitators, especially for sharing their knowledge and skills. However, a few teachers said that their students would have engaged better if the pace was faster and the facilitator maintained a focus on the whole class even when assisting individuals and small groups.

In 2024, EngineeringUK undertook a new small-scale research project into teachers' and students' perceptions and experiences of Professional Engineering Institutions (PEI). The interviews found examples where these organisations had:

- run competitions that also provided careers information
- provided CPD resources and best practice guides for teachers
- talked to teacher trainees and at NQT events
- done careers talks and fairs in schools

PEI expertise was widely praised – but participating teachers wanted PEIs to come into their schools more. From schools' perspectives, these expert STEM outreach providers could help busy

[12] Final Blueprint learnings from teacher interviews, 2024. Unpublished.

teachers with practical investigations, make the curriculum come alive with up-to-date industry knowledge and provide high quality resources and contacts.[13]

Approval processes

Crucially, the decision to participate is usually not for teachers to make alone. Heads of Department and SLTs usually have to give their approval. While teachers tended to find it reasonably easy to gain approval, this step can be difficult because SLT members may see teacher-led approaches as adding to staff workloads, disrupting the curriculum schedule or costly. This highlights the need for clear messaging when publicising the resources, letting teachers and SLT members know exactly what they are responsible for, how it fits into the curriculum and whether there any associated costs or funds available.

Variability in the content delivered by teachers

Facilitators usually deliver the same content in every school that they visit. Evaluators noticed much more variation between teachers, which could be interpreted as a strength or weakness. There is more consistency, and standardisation of delivery, when one facilitator does the delivery in multiple schools.

At present, it is difficult to know how many and which teachers have delivered our resources after downloading them. Teachers may be accessing the resources as part of a 'discovery phase', searching for content across many sites, or planning well in advance. Whether they come back to this content and deliver it in the same format as they described on the original form is an unknown, which makes precise monitoring and evaluation a challenge. Compared with facilitator-led delivery, where monitoring and evaluation data can be estimated and collected directly, evaluating teacher-led activities requires more assumptions around the content's reach and the fidelity of its delivery.

Key learnings and recommendations

This paper has documented the various teacher-led delivery approaches used at EngineeringUK over the last 3 years and how they have been implemented. It also presented an analysis of available evaluation evidence on the benefits and challenges of both teacher-led and facilitator-led models.

Teacher-led programmes succeeded in raising students' awareness of the breadth of engineering jobs and gave students valuable opportunities to develop skills relevant to engineering and wider STEM careers. Some students were left with an appetite for more STEM activities in the future and interest in careers in engineering, science or technology. However, student engagement in teacher-led activities was lower than that recorded in our evaluations of facilitator-led activities,

[13] PEI insights teacher survey open text responses and categories, 2024. Unpublished.

though not unexpected, as teacher-led activities are delivered in a familiar setting and during regular lessons. Facilitator-led activities are more exciting and effective for bringing industry and careers knowledge into schools, but they are costly and in high demand.

Teachers were keen to take part when resources were high quality and covered new, engaging content that linked to and beyond the curriculum. Feedback was very positive, and teachers valued the extra support provided (e.g., guidance, instructional videos, etc).

Teachers are looking for inspirational content that is both 'off-the-peg' but flexible, so they can adapt it to their timings, confidence levels and students. They and their colleagues require additional support for their confidence and time-efficiency.

Including careers-related content and industry expertise in teacher-led materials (and from facilitators) is particularly valuable. But teachers need support to teach the content effectively. Teacher-led activities should be flexible and include links to students' interests to keep them engaged, real-world relevance, and draw connections between the curriculum and potential career opportunities.

Outreach providers need to accept and plan for the difficulties associated with teacher-led delivery, such as tracking reach and having less control over which content is presented. Evaluations of teacher-led approaches need to take these into consideration when interpreting the data to ensure they don't overextend their findings and to make sure recommendations for ongoing programme development are useful and accurate.

Support teachers to reflect on the content and develop the confidence to deliver these activities to increase initial uptake and repeated delivery. Teacher-led delivery is a practical way to increase students' STEM experiences, which is key to shaping their long-term career choices, aspirations, and skills, but providers need to support teachers to unlock this opportunity.

To increase uptake of teacher-led approaches, outreach providers need to clearly communicate the availability of resources, support the SLT approval process, explain how the content meets student and teacher needs, and ensure resources are fully developed. The extended reach of teacher-led delivery isn't guaranteed and there are several barriers to teacher participation that must be addressed for these approaches to succeed.