Enhancing STEM education in secondary schools

Outputs of the Engineering Engagement Programme

February 2013
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The Royal Academy of Engineering report *Jobs and Growth* (September 2012) demonstrated how engineers and technicians are found undertaking technological roles throughout the UK economy and that the demand for engineering skills in the economy exceeds supply.

Despite wages in engineering being high and there being multiple routes into the engineering profession, including the apprenticeship route, young people in the UK still know little about engineering careers and are far more likely to consider other career options.

The Royal Academy of Engineering has been working for many years and in different ways to change this situation. Engineering is vital to the prosperity of the UK and offers excellent life choices for those who enter the profession. The Engineering Engagement Programme is one component of this work.

The programme works at the heart of partner schools, seeking to create an ethos where engineering is seen as intrinsically worthwhile and relevant to pupils from all backgrounds. It aims to provide practical and authentic engineering experiences for pupils and professional support for the teachers and role models that help the pupils learn.

The programme benefited from embedded evaluation from day one. This has given unique insights into what works when it comes to engineering in secondary schools. It is hoped that teachers, parents and all those concerned with engineering education will find inspiration in these pages.

**Matthew Harrison**  
February 2013
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Introduction

**Delivery of the Engineering Engagement Programme**

**Programme aim**

Over the first three years of its operation, the Engineering Engagement Programme at the Royal Academy of Engineering sought to widen participation in science, technology, engineering and mathematics (STEM) by supporting teaching and learning in these areas at Key Stage 3 (ages 11-13). By training teachers to exemplify the role of engineering in society in a practical and engaging way, students learnt about the roles of engineers, what they create and how their ideas and expertise shape our world and improve our lives.

**Programme timelines**

A full-time programme manager was employed by the Academy in April 2009 to set up the programme and lay the foundations for a successful launch in network schools in September 2009. A Resource and Training Coordinator was also employed by the Academy from June 2010 until March 2012. The programme then ran for three full academic years, concluding at the end of July 2012.

**The approach**

The Engineering Engagement Programme has created a national network of schools and teachers who have worked with the Academy to build engineering into the ethos of their schools, enabling students to foster an appetite for STEM subjects and forging lasting relationships between their schools, national teaching and learning support organisations and local industry.

Although this was an Academy-led programme, the Academy very much values the importance of partnership working with other national STEM organisations to increase the reach of its educational programmes. To this end, the Resource and Training Coordinator recruited by the Academy was seconded to STEMNET. This approach helped to enhance engineering and technology within STEMNET’s activities and enabled closer working relationships to be formed between the Academy and STEMNET’s regional contract holders.

A number of service level agreements were signed between the Academy and national STEM organisations such as MyScience who were involved in the STEM club leader CPD strand of the programme.
and the National Science Learning Centre who were involved in the D&T teacher CPD strand. A service level agreement was also signed with the University of the West of England who delivered teacher training and set up after school technology clubs in the Bristol area.

The programme

The Engineering Engagement Programme had four main areas of support; learning resources, after-school STEM clubs and club leader CPD, role models, and D&T teacher CPD. A brief overview of each area of support is given below, but a more detailed outline is given in the Outputs chapter.

Learning resources

A learning resource is defined here as a carefully constructed package of materials designed to support learning. A total of 27 learning resources were produced and disseminated to network schools, giving them access to exciting new curriculum resources for use in lessons or in after-school clubs that demonstrate the links between the curriculum and real-world engineering.

After-school STEM clubs and club leader CPD

Support and guidance was provided to teachers who wanted to set up a new after-school STEM club or who wanted help with running an existing club. This included CPD for club leaders, advice about inspirational STEM activities and £200 grants for hard-to-reach schools. The grant helped towards the purchase of start-up kits for those who were setting up a club for the first time.

Role models

Engineering booster training for STEM Ambassadors was developed and delivered to STEM Ambassadors via a cascade model through the regional STEMNET contract holders.

D&T teacher CPD

Three new face-to-face courses and two new online courses were developed by the National Science Learning Centre to support teachers of Design & Technology.

The results

By the end of July 2012, the programme had worked directly with over 300 schools. It had funded the setting up of 87 new after-school STEM clubs allowing some 1,740 students to benefit. Project scorecard data has shown that included in this figure are approximately 660 girls. 287 club leaders have benefited from the ‘Engineering in STEM Clubs’ CPD.
Over 400 ‘Engineering Ideas' boxes and over 300 ‘Athlete or Machine?’ boxes plus associated training have been disseminated to schools nationwide. Five new D&T teacher CPD courses were developed leading to 498 teachers receiving training. Twenty seven new learning resources were developed, which, as at the end of October 2012, have been downloaded 17,400 times. Engineering booster training was given to 544 STEM Ambassadors.

Feedback received from partners and participants of the programme, both directly to the Academy and via our independent evaluator, show that the programme has been a success. In bringing together outcomes from all strands of the project, the overview evaluation report concluded that the project achieved its aims and was judged by participants to have been successful in providing them with both training they enjoyed and resources which they found useful.

An extract from a wider evaluation on project partners’ perspectives and project legacy:

“Partners all viewed the project to have achieved significant successes. Project organisers felt that the EEnP had successfully highlighted engineering and technology in the STEM agenda. The resources and CPD were viewed to have effectively raised awareness of engineering messages and confidence among teachers and ambassadors in working with KS3 students on engineering-related tasks. The online resources were seen as a real and valuable legacy of the project that would spread these engineering messages in schools. A further success of the project has been the uptake of STEM ambassador training by industry and the involvement of industry in developing resources to add to those developed by the resource coordinator.

The CPD for D&T teachers was well received by teachers who participated and organisers were optimistic that the training would impact well on their practice. The online course was viewed positively as encouraging engagement with pedagogy related to D&T among teachers. However, the courses had struggled to recruit and due to a shift in government focus away from STEM in schools, match funding for courses by the DfE has not continued. The online course was seen as sustainable if money is made available for marketing. The online courses were also seen to have made an important contribution in piloting a new approach to D&T CPD.

The project model was viewed as a strategic one with the potential to reach into schools across the UK. However, needs for more time and further funding were identified. An issue highlighted by the Project Manager was that, despite the success of project strands, EEnP partners DATA, the SLC and STEMNET, were not prepared to integrate the work of the project into their own programmes without continued additional funding.”
Learning resources

Through implementing what the Academy learned from delivering other successful STEM outreach programmes, such as the London Engineering Project, the development of practical, hands-on engineering activities which give students the opportunity to explore an identity of themselves as future engineers, was at the very heart of the Engineering Engagement Programme.

The programme developed a total of 27 learning resources, and these are broken down as:

- 15 student activity resources;
- 4 support resources for teachers and STEM club leaders;
- 5 support resources for STEM ambassadors;
- 3 teaching and learning resources for teachers.

Each of these learning resources can be viewed on the following pages along with a link to access and download the resources in full.

The resources have been disseminated to teachers in hard copy format through the ‘Engineering Ideas’ box (see after-school STEM clubs and club leader CPD section) and are also available for free download on the Academy website¹, TES Online² and on the Resources for Teachers section of the BAE Systems Education Programme website³. STEM Ambassadors have also been trained in how to use the resources in schools (see role models section).

The learning resources have proved to be very popular and statistics giving the number of downloads from the Academy’s website and TES Online show that they have been downloaded some 17,400 times between January 2011 and October 2012.

¹ www.raeng.org.uk/education/eenp/engineering_resources/default.htm
² www.tes.co.uk/education/teaching-resources
³ www.baesystemseducationprogramme.com
<table>
<thead>
<tr>
<th>Resource</th>
<th>TES Online</th>
<th>Academy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athlete or Machine? Bob Skeleton</td>
<td>845</td>
<td>2,879</td>
<td>3,724</td>
</tr>
<tr>
<td>Milking It</td>
<td>1,009</td>
<td>612</td>
<td>1,621</td>
</tr>
<tr>
<td>Perfect Pylons</td>
<td>254</td>
<td>864</td>
<td>1,118</td>
</tr>
<tr>
<td>The Right Switch</td>
<td>158</td>
<td>885</td>
<td>1,043</td>
</tr>
<tr>
<td>Smart Muscle</td>
<td>343</td>
<td>682</td>
<td>1,025</td>
</tr>
<tr>
<td>Moving House</td>
<td>397</td>
<td>587</td>
<td>984</td>
</tr>
<tr>
<td>Engineering Message (Ambassadors)</td>
<td>0</td>
<td>880</td>
<td>880</td>
</tr>
<tr>
<td>The Whole Package</td>
<td>387</td>
<td>418</td>
<td>805</td>
</tr>
<tr>
<td>Captivating Cornflour</td>
<td>144</td>
<td>586</td>
<td>730</td>
</tr>
<tr>
<td>In Control</td>
<td>203</td>
<td>484</td>
<td>687</td>
</tr>
<tr>
<td>Routes into Engineering (Ambassadors)</td>
<td>0</td>
<td>534</td>
<td>534</td>
</tr>
<tr>
<td>Routes into Engineering (Teachers)</td>
<td>19</td>
<td>501</td>
<td>520</td>
</tr>
<tr>
<td>Take Off</td>
<td>32</td>
<td>474</td>
<td>506</td>
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<td>Engineer’s Brain</td>
<td>26</td>
<td>461</td>
<td>487</td>
</tr>
<tr>
<td>Rescue Rail</td>
<td>39</td>
<td>430</td>
<td>469</td>
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<td>Introduction (Teachers)</td>
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<td>398</td>
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<tr>
<td>Keeping It Cool</td>
<td>25</td>
<td>353</td>
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<td>317</td>
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<tr>
<td>Diversity (Ambassadors)</td>
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<td>289</td>
<td>289</td>
</tr>
<tr>
<td>Making Music</td>
<td>0</td>
<td>253</td>
<td>253</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,933</strong></td>
<td><strong>13,467</strong></td>
<td><strong>17,400</strong></td>
</tr>
</tbody>
</table>

*Table 1: Number of resource downloads (January ’11 – October ’12)*
Student activity resources

The following pages show the quick, easy and inexpensive student activity resources developed for the programme. These can be used in the classroom or in after-school STEM clubs to spark inspiration and show the diversity of engineering.

Each activity offers curriculum links, handy hints, engineer or company profiles and tips for further work.
Creating Captivating Cornflour - discover the properties of this curious material and make an engineered product.

www.raeng.org.uk/education/Cornflour.pdf
In The 21st Century...

...most UK households consume large amounts of energy. We need energy to power TVs, computers, stereos and many more electrical gadgets.

As we try to use more renewable sources of energy and reduce our use of fossil fuels, it is important to ensure that electricity gets to us in an easy but efficient way; we do not want to waste any!

This session should fill a club timeslot as a one-off project.

During this session your group will apply their knowledge of materials, forces and structures, build their model pylons and test to see how strong their models are.

What You Need

- 15 craft straws
- A glue gun
- Scissors
- Four pieces of string about 30 cm long
- Four 20 g masses
- A ball of modelling clay about 3 cm across
- A desk fan
- Stopwatch

Note for STEM Ambassadors - Schools will have many of the items you need, so check with the teacher before your session. A risk assessment should be done before starting this activity.

Perfect Pylons - this resource allows groups of students to apply their knowledge of materials, forces and structures, build their model pylons and test to see how strong their models are.

www.raeng.org.uk/education/Perfect_Pylons.pdf
In Control - this resource allows students to take on a variety of different roles within a group and work as a team to creatively solve an engineering problem.

www.raeng.org.uk/education/In_Control.pdf
The Right Switch - a look at technical textiles and a chance to use QTC (quantum tunnelling composite) to make a textile switch.

www.raeng.org.uk/education/The_Right_Switch.pdf
The Whole Package - use thermochromatic paints and make some smart packaging.

www.raeng.org.uk/education/The_Whole_Package.pdf
Milking It - this resource allows students to explore how to make plastics and experiment with different ideas for applications.

www.raeng.org.uk/education/Milking_It.pdf
Smart Muscle – this resource allows students to question the properties of materials and model a muscle based on a smart spring.

www.raeng.org.uk/education/Smart_Muscle.pdf
Moving House - this resource allows students to make their own reinforced jellies and test to see whether they can withstand vibrations, to mimic an earthquake situation.

www.raeng.org.uk/education/Moving_House.pdf
Keeping It Cool - this activity introduces ideas about keeping materials and tools cool while in space and looks at how the Solar Orbiter is being designed to protect its payload from energy transfer.

www.raeng.org.uk/education/Keeping_it_cool.pdf
The Engineer’s Brain - this resource allows students to explore how biology can be the inspiration for engineering and discover the ideas behind how we can form images of the brain and see how people think.

www.raeng.org.uk/education/The_Engineers_Brain.pdf
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Take Off – students will explore the design and development of aircraft carriers and apply these ideas to build their own models.

www.raeng.org.uk/education/Take_Off.pdf
Rescue Rail - students will explore the design and technology needed in our railways and apply these ideas to build their own models.

www.raeng.org.uk/education/Rescue_Rail.pdf
Enhancing STEM education in secondary schools: Outputs of the Engineering Engagement Programme

Making Music - during this session students will model musical instruments, and investigate the musical notes they produce; how close can they get to the notes produced by real instruments?

www.raeng.org.uk/education/Making_Music.pdf
Enhancing STEM education in secondary schools: Outputs of the Engineering Engagement Programme

Royal Academy of Engineering

Body Worn Antennae – Developed to support the BAE Systems Schools Roadshow 2012, this resource explores what an electronic textile is, the different forms of electronic textiles and how they are manufactured.

www.raeng.org.uk/education/Body_Worn_Antennae.pdf
Support resources

Teachers and STEM club leaders

The following pages show the support resources developed by the programme which cover some key ideas such as ‘The Engineering Message’ and ‘Routes into Engineering’.

Teachers and STEM club leaders can use the resources and profiles of engineers to prepare for sessions and use the tasks to introduce ideas and start discussions with students.
Introduction - this resource briefly introduces STEM Clubs to teachers and is packed with useful links and contacts to help set up and run a club.

www.raeng.org.uk/education/Introduction.pdf
The Engineering Message

A definition of an engineer is...

“the discipline, art and profession of acquiring and applying scientific, mathematical, economic, social, and practical knowledge to design and build structures, machines, devices, systems, materials and processes that safely realise solutions to the needs of society.”

And a definition of engineering is...

“a professional practitioner of engineering, concerned with applying scientific knowledge, mathematics, economics and ingenuity to develop solutions to meet economic and societal needs”

Does Your Audience Agree With These Definitions?

By working through this resource you will be able to help students understand The Engineering Message, and develop their understanding of engineers and engineering.

Remember this is a starting point for discussion and activity and you can draw upon your own enthusiasm and experience.

What Is Engineering?

Many people think that engineering is just about fixing cars or constructing bridges, ships or buildings.

Some will also have the impression that engineering takes place in a dirty environment that isn’t for them, but in fact engineering helps shape the future.

Engineers look to develop and manufacture sustainable products, materials, structures and much more.

Find out what your group thinks of engineering:

You will need some fabric paints and old, extra large T-shirts (alternatively you can use just paints and paper or even badges).

Ask your group to draw ‘engineering’ on a T-shirt.

They may draw a person or product, building or bridge etc.

Once dry, ask them to wear the T-shirt over their clothes and explain their drawing.

Have they drawn an engineering stereotype?

Allow time for this discussion. We want to show students that engineers are from diverse backgrounds and work in many varied industries. During the activity, challenge the students’ stereotypes. Use the profiles provided throughout The Engineering Engagement Project resources to help you.

The Engineering Message - just what is ‘engineering’ and how can we portray it in a positive way which breaks down stereotypes?

This resource is aimed at helping teachers talk about these issues.

www.raeng.org.uk/education/The_Engineering_Message.pdf
Diversity

The twenty first century continues to see an increase in technological and engineering advancements: including smart-phones, electric cars, high speed rail links and countless more.

Challenging Stereotypes Activity

In small teams ask your students to draw or describe a picture of an ‘Engineer’: *(This is a chance to be creative. Perhaps you could encourage the group to create a display for the classroom?)*

Ask the students to explain their drawings or descriptions. Encourage your audience to discuss any stereotypes together. Do they all agree? Challenge engineering stereotypes.

Diversity - just as engineering is diverse, so are engineers, but we do not have enough engineers for the challenges ahead. The resource looks at how we can engage more students in engineering.

www.raeng.org.uk/education/Diversity.pdf
Enhancing STEM education in secondary schools: Outputs of the Engineering Engagement Programme

Routes into Engineering - this resource offers hints and tips to help teachers discuss engineering careers and offers links to other good careers resources.

www.raeng.org.uk/education/Routes_into_Engineering.pdf
Support resources

**STEM Ambassadors**

The following pages show the support resources developed by the programme which cover some key ideas such as ‘The Engineering Message’ and ‘Routes into Engineering’.

**STEM Ambassadors can use the resources and profiles of engineers to prepare for sessions and use the tasks to introduce ideas and start discussions with students.**
Role Models Support - this resource gives STEM Ambassadors useful links, contacts and ideas for working with schools.

www.raeng.org.uk/education/Ambassador_Introduction.pdf
The Engineering Message – just what is engineering and how can we portray it in a positive way which breaks down stereotypes? This resource is aimed at helping STEM Ambassadors talk about these issues.

www.raeng.org.uk/education/The_Engineering_Message.pdf
Enhancing STEM education in secondary schools: Outputs of the Engineering Engagement Programme

**Diversity**

The 21st century continues to see an increase in technological advancements: from MP3 players to electric cars, nanotechnology to skyscrapers. If we want to continue the rate of technological evolution we will need more people working in science, technology, engineering and maths (STEM).

It Can Often Be Hard To Engage Everyone In A Group...

Some students may not understand what engineering is, others may be fully engaged in another subject, while for some engineering may appear too hard or culturally irrelevant.

We hope that by using this resource you will have the greatest chance of inspiring all young people, regardless of their background, to see engineering and technology as positively beneficial to their present and future lives.

You might not use all of these tasks, but we are confident that you will find many useful.

**Challenging Stereotypes Activity**

In small teams, ask your audience to draw or describe a picture of an engineer.

- This is a chance to be creative. Perhaps you could encourage the group to create a large image of engineering to display in their school.
- Ask the students to explain their drawings or descriptions.
- Encourage your audience to discuss these stereotypes together and most importantly challenge them!
- Allow time for this discussion. We want to show students that engineers are from diverse backgrounds and work in many varied industries.
- During the activity challenge the students’ stereotypes. Use the profiles provided throughout the Engineering Engagement Project resources to help you.

**Diversity** - just as engineering is diverse, so are engineers, but we do not have enough engineers for the challenges ahead. The resource looks at how STEM Ambassadors can engage more students in engineering.

Enhancing STEM education in secondary schools: Outputs of the Engineering Engagement Programme

Royal Academy of Engineering

Routes into Engineering - this resource offers hints and tips to help STEM Ambassadors discuss engineering careers and offers links to other good careers resources.

www.raeng.org.uk/education/Routes_Into_Engineering.pdf
Enhancing STEM education in secondary schools: Outputs of the Engineering Engagement Programme

Engineering For Non Engineers

There are many aspects of science and maths that need or use technology and engineering. This resource is aimed at STEM Ambassadors who are not trained engineers, but who work in an engineering related field.

Used in combination with the other support resources (The Engineering Message, Diversity and Routes into Engineering) the information and tasks explained here will help engage you and your audience with different aspects of engineering.

Remember this is a starting point for discussion and activity. Why not use in conjunction with one of our activity resources? www.raeng.org.uk/eenresources

Engineering is Everywhere

A good way to test this theory is to split your audience into small teams and give them each a part of the room, and a pack of small post-it notes.

Using the post-it notes ask the group to put a note on anything they can see that they think involves engineering.

Ask each group to discuss one object they think has been engineered. What objects have they missed out? What are your audience’s reasons? What do they think engineering is?

Allow time for the students to reflect on their answers, would they change them if asked again?

Engineering: Belief Circles

Another great way to discover and develop a group’s ideas and awareness about engineering is the use of belief circles.


Engineering for Non Engineers - there are many aspects of science and maths that need or use technology and engineering. This resource is aimed at STEM Ambassadors who are not trained engineers.

www.raeng.org.uk/education/Engineering_for_Non_Engineers.pdf
Teaching and learning resources for teachers

The following pages show the teaching and learning resources that have been developed for the programme.

Targeted at Key Stage 3, the resources combine design and technology, mathematics and science activities to investigate a big question.
In order to answer the big question, students must identify factors that influence the performance of the bob skeleton and investigate each one through practical, mathematical and scientific activities.

By encouraging STEM learning based on student-led investigation, problem solving and higher-order thinking, students will be able to provide their own enquiry-led, sophisticated and justified answer to a difficult real-world question.

www.raeng.org.uk/education/bob_pack_WEB.pdf
Winning medals: does engineering design make a difference?

The aim of this resource is to give students the opportunity to investigate the impact of science, technology, engineering and mathematics (STEM) on wheelchair sport.

The success of any athlete is the result of many hours of training, dedication and sacrifice. However, in the case of wheelchair athletes there is an added dimension – the work of the engineer who designed the wheelchair.

So when a wheelchair athlete wins a medal, to what extent has engineering design made a difference to the wheelchair athlete’s performance?

www.raeng.org.uk/education/winning_medals.htm
The winning medals resource was successfully used by BAE Systems in their first Malaysian Education Road Show programme in Bintulu, Borneo, which took place from the 5 to 7 November 2012. The road show was held in collaboration with Might-Meteor Advanced Manufacturing Sdn Bhd.

The road show comprised a series of workshops at three selected secondary schools in Bintulu and involved more than 200 students, aged between 13 and 17 years old, and their teachers. The road show aimed to develop students’ knowledge of and interest in engineering as a career, as well as to demonstrate to students that science and engineering can be fun by bringing the science of athletics to life.

**Photos of some of the students involved in the school outreach programme and using the winning medals resource can be seen below:**

![Students involved in the Malaysian Education Road Show, 5-7 November 2012]
Students from the Malaysian Education Road Show getting to grips with the Winning Medals resource
Students from the Malaysian Education Road Show testing their wheelchair designs
After-school STEM clubs and club leader CPD

After-school STEM clubs

In realising the importance of after-school clubs in allowing students to explore STEM subjects in a stimulating learning environment, and away from the constraints of the school timetable, the programme funded the setting up of 87 new STEM clubs in schools which did not already have one. The grants funded the purchase of reusable engineering and technology kits to run hands-on activities in after-school clubs.

The £200 grants were made available to hard-to-reach schools. A school was classified as hard-to-reach either by its location (ie in an area of high deprivation) or if more than 10% of their students were eligible for free school meals.

Using an average of 20 students per club, the funding has benefited some 1,740 students and, given the emphasis the programme put on the engagement of girls in these clubs, included in this number were approximately 660 girls.

Schools receiving a grant were asked to complete a scorecard so we could hear about the exciting things that they had been up to and a small sample of these are given below:

<table>
<thead>
<tr>
<th>School name</th>
<th>Ysgol Clywedog</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of students attending</td>
<td>12</td>
</tr>
<tr>
<td>No of girls attending</td>
<td>5</td>
</tr>
<tr>
<td>Exciting stuff!</td>
<td>All members have achieved their Bronze Crest Awards.</td>
</tr>
<tr>
<td></td>
<td>Team made the Grand Finale of Make-it-in-Manufacturing.</td>
</tr>
<tr>
<td></td>
<td>Long project on sustainable energy to be presented to whole school next term.</td>
</tr>
<tr>
<td></td>
<td>The profile of engineering and electronics has been raised so that the update of these subjects for next year is unprecedented!</td>
</tr>
<tr>
<td></td>
<td>The grant has gone towards mainly replacing resources used by the club so that it can continue with new members next year and the year after. We have no financial support from the school so without grants such as this we would have to close or charge.</td>
</tr>
</tbody>
</table>
### Christ the King Catholic Maths and Computing College

<table>
<thead>
<tr>
<th>School name</th>
<th>No of students attending</th>
<th>No of girls attending</th>
<th>Exciting stuff!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christ the King Catholic Maths and Computing College</td>
<td>8</td>
<td>5</td>
<td>The £200 grant allowed the team to compete in a national ‘make it happen’ challenge held in Lancashire. The task was to set up a mini enterprise company that designed, built and sold a specific robotic prototype for the emergency services. Each student was given a role and set a brief that allowed the team to win prizes. The same club is now moving on to compete in other regional competitions within the county while at the same time entering for the Crest and STEM Leaders award.</td>
</tr>
</tbody>
</table>

### Highfields Science Specialist School

<table>
<thead>
<tr>
<th>School name</th>
<th>No of students attending</th>
<th>No of girls attending</th>
<th>Exciting stuff!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highfields Science Specialist School</td>
<td>30+</td>
<td>20</td>
<td>Last year, we had over 30 students obtain their Bronze Crest Award which was carried out and supported by the STEM club. Several of these competed at the regional finals at Cosford and one group came as a runner up. We are hoping to attend the national awards later this academic year. Last year we also hosted a STEM Fair where we showcased the work of our STEM students, invited outside organisations including a lifesize robot and invited local primary schools. This was covered by our local newspaper too. This year, we have 11 of these students now going on to obtain a Silver Crest Award and working with a number of outside agencies including Carillion and the Institute of Physics. Furthermore we have a group of new students taking part in a solar-powered car competition with RapidOnline and also the Space Design Competition through the National STEM Centres. These students will go on to complete their Bronze Crest Awards later in the year. The grant was essential in getting the club off the ground and if there are more grants available this would be brilliant as we are trying to secure funding for our current year projects.</td>
</tr>
</tbody>
</table>
### Wallington High School for Girls

**School name**
Wallington High School for Girls

**No of students attending**
6–12

**No of girls attending**
Girls’ school

**Exciting stuff!**
Students have particularly enjoyed exploring scientific ideas through discussion and (messy) practical activities. Activities so far have helped consolidate and extend their understanding of solids, liquids and gases, acids and alkalis, pressure and changing properties of plastics. We had lots of fun with thermite reactions and methane bubbles.

Next week we will be trying out the making plastics from milk activity which looks fun and will consolidate and extend their knowledge of monomers and polymers.

So far the activities have been more related to chemical engineering but we hope to run some building challenges soon which will help with the other disciplines such as civil engineering.

### St Matthew’s RC High School

**School name**
St Matthew’s RC High School

**No of students attending**
14

**No of girls attending**
7

**Exciting stuff!**
With our grant we have purchased some electric motors (something we haven’t had in the science department before), so now the STEM club students can engage in projects concerning energy, efficiency, power etc, and of course this equipment will benefit whole school science and engineering learning.

We have planned outings in the near future to the Museum of Science and Industry in Manchester and the brand new Discovery Centre at Jodrell Bank.
Enhancing STEM education in secondary schools: Outputs of the Engineering Engagement Programme

**School name**

Draper’s Academy

**No of students attending**

16

**No of girls attending**

6

**Exciting stuff!**

The club has been running for two weeks so far and the response has been fantastic. We have worked on a marble run project in week 1 to get the pupils into it and looked at various forces which impact on the marble, such as friction, gravity, materials used in the track, the slope (incline) and the weight of the ball.

We started the *Athlete or Machine?* Bob skeleton project last week which the children have really enjoyed so far and some have even been coming in at lunch times to work on the task outside of the scheduled club time.

**Club leader CPD**

The Academy worked with *Myscience* and STEMNET in the development, promotion and delivery of ‘Engineering in STEM Clubs’ CPD for club leaders.

A ‘train the trainer’ model was used very successfully for this strand of the project. The national roll-out of the CPD events led to 25 champion schools receiving training; these champions then went on to cascade the training to a further 262 teachers from 188 different schools.

The development and promotion of the Engineering Ideas Box (EIB) also attributed to the success of this strand of the programme. The EIB, valued at approximately £75, contains printed copies of the STEM club resources shown earlier plus some accompanying kit, and was given free to schools who attended the CPD session.

A typical Engineering in STEM Clubs CPD session included training on how to use the STEM club resources and kit within the EIB, how to set up a STEM club, recruitment, diversity in engineering, engineering careers and how to engage with STEM Ambassadors to enhance and help support a club. A sample PowerPoint presentation from one of these sessions can be seen on the following pages:
Engineering in STEM Clubs
Training for Trainers 2011

Outcomes for today:
• Introduce the materials and CPD package
• Develop a shared idea of the RAEng’s messages
• Experience the CPD package as a participant
• Plan for your own training session.

Today’s Agenda
• Welcome and Introductions
• CPD Overview
• The Engineering Message
• What’s the difference?
• Diversity
• Getting Girls into Engineering
• Routes into Engineering
• Practical Activities
• Trainers Tools
• Next Steps

The Royal Academy of Engineering, STEMNET and the STEM Learning Centres have worked together to develop Engineering CPD for STEM Club Leaders.

We want to give STEM Club Leaders the greatest chance of inspiring all young people, regardless of their background, to see engineering and technology as positively beneficial to their present and future lives.

The Engineering Message

What’s the difference?

Diversity

Getting Girls into Engineering
Elements of the Engineering in STEM Clubs CPD are now part of the basic STEMNET training delivered to teachers around the UK.

Over 400 EIBs, along with the associated training have now been given to schools nationwide.

AN IMAGE OF THE EIB CAN BE SEEN BELOW:

Following on from the success of the Athlete or Machine? teaching and learning resource and the popularity of the Engineering Ideas Box, the Bob in a Box (BIB) was also developed.

The BIB, valued at approximately £45, contains a hard copy of the Athlete or Machine? resource and enough kit to enable a group of students to construct, test and launch their own skeleton bobs. The BIB can be completed over a series of STEM club sessions or can be used as a whole day STEM Challenge. Completion of the resource in its entirety will lead to students receiving a Bronze CREST Award from the British Science Association.

Over 300 of these boxes, plus associated training, have been given to schools nationwide using a ‘train the trainer’ cascade model.
An extract from the evaluation of the Club Leader CPD and Engineering Ideas Box resources:

“Generalisations cannot be made on the basis of the small sample represented in this evaluation. There are, however, indications here that the EEnP has been effective in achieving the majority of its aims in schools where the resources have been taken up. The EIB activities and CPD certainly appear to be encouraging teachers to provide an ‘engaging STEM education’ and pupils in STEM clubs were aware of the connections between STEM subjects and most were interested in pursuing STEM careers. The EIB activities were also encouraging science teachers, in particular, to develop STEM rather than strictly science-based clubs - though in several instances this was already underway before work with the EEnP. The contextualisation of the activities resonated with teachers and was seen as an important way to engage pupils. Activities were being taken up and integrated into existing practice and in a couple of instances, were being used to set up a new club or restart an old club. Teachers also discussed using activities in lessons. Club leaders all discussed continuing to work with the EIB in the future, so the project appears to be likely to have a sustainable impact.”
Issues did, however, emerge from the evaluation. One was that while the CPD developed by the RAEng had as its central focus diversity issues, engineering messages and engineering careers, these foci did not resonate with club leaders’ priorities. Their primary preoccupation was to identify accessible, engaging, practical resources. Club leaders were not using the diversity, careers and engineering messages resources and it may be that the CPD would have been better focused on the practical activities in the EIB and how to relate these to diversity issues, engineering careers and messages to maximise impact in these areas. Some teachers expressed confusion over how to use the resources and if CPD had focused on activities, the uptake of resources in schools may have been increased as teachers would view them as more accessible. While many schools contacted relayed plans to use the resources in the future, their lack of familiarity with the contents of the box and how they are used may impact on the number of schools using resources.”

Role models

The Academy worked with STEMNET, who run the national STEM Ambassador programme, and their regional contract holders, to provide STEM Ambassadors with engineering booster training.

STEM Ambassadors are volunteers who give their time to go into schools to support their STEM delivery. They can support after-school STEM clubs, give careers talks and support classroom curriculum activities.

The engineering booster training covered certain engineering-specific issues that are not prominent in other STEM subjects. It was designed to be delivered in addition to the compulsory basic training that all STEM Ambassadors have to undertake when they sign up. As well as receiving training to support teachers in the delivery of the Engineering Ideas Box (see club leader CPD in previous section), Ambassadors were also trained on how to deliver the key engineering messages. These included confidently portraying the vast range of careers available, the various different routes into engineering and that engineering is for girls as well as boys. As a result of this programme, some regional STEMNET contract holders have now included some elements of the engineering booster training as part of their basic training.

The engineering booster training was rolled out nationally via a cascade model whereby the Academy trained staff within the regional STEMNET contract holders, who in turn ran training sessions for their registered STEM Ambassadors. In addition to a small grant to cover the costs of delivering the training session, the contract holders also received kit to the value of £100 to support their training.
There are now 544 engineering booster-trained STEM Ambassadors operating nationally, and some of these have gone on to support another Academy education programme which is supporting the delivery of engineering within high-performing schools. A high proportion of students from these schools go on to study medicine and law at university, but not engineering. Linking a high-performing school up with a booster-trained STEM Ambassador who will train two STEM teachers up on the use of the Engineering Ideas Box and support them in the delivery of its contents, is a really good opportunity to introduce engineering into these schools. In addition, being able to forge a long-term relationship between the school and the STEM Ambassador provides the opportunity for pupils to really get to know Ambassadors, understand their work and so potentially see them as an inspirational role model.

The engineering booster training has also been incorporated into the graduate training programme at GSK.

An extract from the STEM Ambassador Training/Resources evaluation report:

“The ambassador training programme was generally successful, meeting most intended outcomes. After the training sessions, ambassadors reported increased levels of confidence and appeared motivated to go into schools. Ambassadors were effectively made aware of the STEMNET network, available resources and engineering messages, and discussed how they would engage pupils in schools.

Follow-up interviews with ambassadors reveal that ambassadors had gone into schools and were keen to promote engineering messages. However, there were issues of confidence, particularly among the younger, less experienced ambassadors, and some of the contexts within which ambassadors were working seemed to be limiting their ability to promote engineering messages and to act as role models. Constraints on ambassadors’ time also presented some issues.”

**D&T teacher CPD**

The Teaching Tomorrow’s Designers and Technologists Today (TTDTT) project was jointly funded by the Royal Academy of Engineering through this programme and the Department for Education (DfE). Myscience, closely supported by the Design and Technology Association, provided key inputs on this component of the Engineering Engagement Programme.

The focus of the TTDTT project has involved better coordination and collaboration around D&T CPD as well as developing and delivering a suite of three face-to-face courses run through the regional Science
Learning Centres (one of which was also run through the National Science Learning Centre) and two online courses (eCPD).

A total of 498 D&T teachers were trained through the programme.

The programme also worked to ensure a sustainable legacy for D&T teachers beyond the lifetime of the project. This included a collation and evaluation exercise of all course materials and resources used during the delivery of the project. Those suitable for inclusion to the Design and Technology Resources collection on the National STEM Centre online platform have been uploaded and are now free to download. The resources can be seen here: http://stem.org.uk/cx3gv

The following comments were received from participants on the online courses:

“I have acquired a better knowledge of circuits and how textiles fastenings can effectively be used in circuits. Now able to do basic programming of daisy pics. With my new knowledge and skills I now feel much more confident in teaching the basic skills and am already teaching two new schemes of work as a result of this course“.

“I have used the lamp-making as a focused practical task for my new Year 13 students, to remind them that textiles can be used in many ways. I have never seen this class so focused and motivated to complete an activity before. I am currently teaching a D&T teacher how to make and teach the Year 8 SOW“.

“This has provoked real interest in my colleagues in the department. We have already planned to make changes to the Year 9 SOW and have altered groupings so as to trial this with high aptitude classes in the first instance. We also intend to do some after-school work with gifted and talented students and will use electronics as the medium to join the traditional boys areas’ of D&T with the girls’ areas of Textiles“.

An extract from the evaluation of the face-to-face courses:

“The courses both largely met planned learning outcomes and participants were predominantly positive about the courses and were engaged by most sessions. The collaborative approach taken by facilitators and the opportunity to work alongside other practitioners was clearly valued by participants many of whom talked about their isolation in teaching electronics in their school contexts.
“Participants engaged with the discussion about D&T and the need to engage with new technology and for pupils to be given the opportunity to be creative with it. It was clear that, in many instances, the course challenged participants’ thinking about teaching D&T. Participants all talked about outcomes for their practice resulting from their attendance on the courses. Many participants intended to use the Bubble Blower activity and the Cyber Pet with their KS3 groups. Participants also talked about trying to work with science departments at their schools. The courses also effectively raised participants’ awareness of the work of STEM ambassadors and of the benefits of providing pupils with a real-world context for D&T.

However, the courses did not recruit well. A factor contributing to this appeared to be the new ‘rarely cover’ rule; budgetary constraints were also an issue for some schools. A further issue was that electronics is not taught at many schools and so there is no perceived need for training. Electronics was already established at the schools represented at the courses. This raises the difficult question of how to engage schools where electronics is not yet taught. A further problem was that the SLCs were not recognised by D&T teachers as venues for D&T courses and information about courses sent to schools may not have reached relevant teachers.”

An extract from the evaluation of the eCPD course: Using Motors in KS3 D&T:

“Some participants found attending courses difficult, especially geographically distant courses; the online format appeared to suit teachers in rural locations who struggled to reach course centres. Participants identified further benefits as being that they do not have to miss classes; senior management were more likely to allow their attendance; online courses are cheaper as there is no need to pay for cover and that the course allowed participants to work when it suits them.

Participants and the course facilitator commented that they have learned at more depth than on one-day face-to-face courses. The course was also seen to allow for a more relevant and deeper level of discussion with the course facilitator and between participants. Participants also commented that the rigor of having to complete assignments ensured that course material was at least ‘covered’.

For IT-literate participants and those familiar with social networking sites, the hub had provided a valuable opportunity for relevant discussion. However, those unfamiliar with social networking sites had not joined discussions and appeared to have felt more isolated.
Participants commented that, when engaging in practical activities, it is preferable to work with other people so that there is someone ‘to explain it’. It was suggested that the lack of instant feedback could lead to participants giving up or posting up results that are ‘completely wrong’. For those lacking knowledge and confidence this could be alienating.

One participant observed that online courses may be “daunting and unsuited to participants who are new to a subject area.”

An extract from the evaluation of the eCPD course: Linking Textiles and Electronics at KS3:

“Participants were unanimously positive about the online format. The benefits outlined included not having to take time out of work, the opportunity to organise their own time and the opportunity the course provided to reflect and develop their ideas.

The course facilitator expressed some concern over whether participants would be able to access instructions as easily as on a face-to-face course. Participants indicated they were happy with the instructions they had received, though it was clear that if technical difficulties were not resolved quickly this would cause frustration and a loss of confidence.

Some concern was also expressed about the extent to which participants were learning from each other. However, all participants did talk about looking at each other’s posts and even gleaning new ideas and better ways of working.

An issue identified by the course facilitator and by participants was the lack of communication between those on the course. Participants described being put off by the silence of other members of the group, being averse to blogging in principle and not having time to blog. It was suggested that this should be a more formal requirement of the course.”
Evaluation summary

An overview evaluation report on all strands of the Engineering Engagement Programme
by Clare Gartland

Introduction

The ambition of the Engineering Engagement Programme (EEnP), which was supported by BAE Systems and led by the Royal Academy of Engineering (RAEng), was to support teaching and learning in schools in the areas of science, technology, engineering and mathematics (STEM). The aim was to widen student and teacher participation in STEM and to highlight the significance of engineering and technology in order to encourage more students to take up engineering-related careers. This was to be achieved by working with a range of project partners from the wider STEM community.

The specific objectives outlined at the start of the project were to:

- Increase teacher confidence and competence by providing high-quality continuing professional development (CPD) in the areas of engineering and design and technology
- Increase the capacity in the engineering and technology elements of the National STEM agenda
- Develop resources and training that help teachers, role models and after-school club leaders to deliver an inspirational and engaging engineering education with a focus on contextualised engineering and career opportunities
- Boost the number of after-school engineering clubs and their engineering content
- Increase the number of students opting for STEM subjects beyond Key Stage 3 and engineering beyond Key Stage 4, or increase attainment
- Build up and work with an optimum mix of partners to ensure effective project delivery
- Adopt a culture of impact across the project
The project had three distinct strands: the first was CPD for Design and Technology (D&T) teachers, the second CPD for STEM club teachers and the third CPD for STEM ambassadors. The club leader and STEM ambassador training were supported throughout by the development of a range of resources for use with students in schools. The CPD for D&T teachers was developed and delivered with Myscience and the Design and Technology Association (DATA). The CPD for STEM ambassadors and STEM club leaders and the associated resources were designed and delivered in partnership with STEMNET.

This summary report provides an overview of the outcomes of all three strands of the EEnP and brings together the findings of individual evaluation reports produced during the lifetime of the project:

- Project partners’ perspectives (August 2011)
- STEMNET project practices and legacy (July 2012)
- Evaluation of D&T teacher CPD: Make it work & Make it move (August 2010)
- Using motors in KS3 D&T: Embedding motor control in your department’s curriculum (eCPD) (May 2011)
- Linking textiles and electronics at KS3 (eCPD) (April 2012)
- STEM Ambassador training (September 2011)
- Stage 1: Evaluation of STEM club CPD and club resources (July 2011)
- Stage 2: Evaluation of STEM club leader CPD and Engineering Ideas Box resources (August 2012)

Evaluation framework

The aims of the evaluation process were two-fold: to provide detailed insights into project impact and to support the development of its work through a constant monitoring process adding to the project’s value. A ‘culture of impact’ was central to the project design and the evaluation process was key to this, ensuring that project organizers were able to use findings in project developments over its whole lifetime. Project developments in turn impacted on the evaluation process and foci.

The specific strategies used to gather data for the evaluation varied according to the context. Where possible, face-to-face interviews were held with project partners and organisers and with STEM club leaders.
Telephone interviews were held with STEM ambassadors and with participants of the online CPD course. A loosely structured approach was taken to all the conversations with the aim of enabling participants to relate and explore their own views and experiences of the project as freely as possible (Kvale 1996). Observation was also used extensively during training sessions and during STEM club sessions. During observation of CPD or club sessions, field notes were taken as a means of recording conversations with participants. Focus groups and interviews were recorded and transcribed in full. These notes and transcripts were coded and analysed drawing on grounded theory (Chramaz, 2003).

The evaluation focused on the three project strands. In each strand the training was observed and the impact on the practice of participants explored; the cascade model used in the STEM ambassador and STEM club leader training was followed during the evaluation. The evaluation took place in different areas across the country including the East Midlands, the North East, the North West, the East of England, the South East and London. As well as following project strands the evaluation explored project organisation, the efficacy of partnership working and project partners’ views of project impact and legacy.

Overview

Project partners perspectives and project legacy

Project partners saw the project as having been generally successful. The partnership model was viewed as having worked well both operationally and also in terms of raising awareness about key issues among project partners and in schools. The takeup of ambassador work by industry partners and the development of a bank of downloadable resources were outcomes viewed as especially positive. Despite a large measure of agreement about project aims and general acknowledgement of the benefits of partnership working, however, practical issues arose around disruption to project work caused by changes of project personnel, the recruitment of teachers to CPD courses, changes in government funding and identifying ways to continue project activities at the end of the projects’ lifetime. There was general agreement that the project model was a strategic and useful one, with the potential to reach into schools across the UK. However, the need for more time and further funding were identified as necessary if this was to be achieved.

Project strands undertaken with STEMNET were generally viewed to have achieved their aims. The cascade model of training for STEM ambassadors and club leaders was positively received and both the training and the project resources were seen as valuable by project participants. Resources have since been taken up by contract holders in various training events with STEM ambassadors, though not all resources were viewed as accessible by all project participants. While the
project concept and structure have been effective and there has been positive engagement with project activities overall, communication emerged as a significant issue throughout. Dissemination of good practice and operational communication between different strands of the project has been appreciably affected by staff turnover during the project. The apparent lack of development of a working network or ‘project community’ of EEnP participants has implications for emerging practice. This largely stems from a specific lack of continuity among central project organisers rather than from any failing in the overall project, but is likely to continue to prevent effective communication across the project and to present an obstacle to sharing and embedding project outcomes.

**D&T teacher CPD**

The CPD courses, *Make it work* and *Make it move*, ran in the spring and summer of 2010 and were successful in many ways. Participants responded positively, were generally engaged and discussed their plans to draw on the courses in their own teaching practice. The courses effectively challenged some participants’ thinking about teaching D&T and encouraged them to consider how to encourage pupils to make links between STEM subjects. A number of issues were raised, however. Participants and facilitators in some instances were unclear about what the intended outcomes were for science sessions, so potentially undermining the possibility of these to impact on practice. The wide range of participants’ backgrounds also made designing the content of these sessions challenging for facilitators. Difficulties experienced in recruiting to the courses remained a significant obstacle with many of the courses being cancelled. This seriously impacted on the planned extent of the reach of the CPD into schools.

The two online courses ‘*Using Motors in KS3 D&T: embedding motor control in your department’s curriculum*’ and ‘*Linking Textiles and Electronics at KS3*’, also developed in collaboration with Myscience and DATA, were clearly successful. Participants all talked about how they would use activities covered in the course in their own teaching practice and how participation had raised awareness of the importance of linking STEM subject areas at their schools. Participants also outlined plans for disseminating their learning amongst colleagues. Participants and facilitators outlined how the online format extended learning and enabled access to CPD. A problem identified for the online format however, was lack of communication between participants and the ongoing difficulties faced by teachers new to subject areas of working in isolation. Recruitment to courses was problematic.

**STEM ambassador training/ resources**

The cascade model used in the training of ambassadors seemed to work effectively and STEM ambassadors and contract holders were generally very positive. A prompt response to contract holders’ concerns about
training at the outset meant they overcame initial reservations about the provision. Resources were well received by ambassadors who felt that the training sessions effectively provided them with ideas about how to work with pupils, and at both training sessions ambassadors said they were generally confident about going into schools and using the resources. Ambassadors also engaged well with engineering messages and were keen to promote these in schools, though they indicated that the ideas and gender and diversity issues raised were not new to them.

Follow-up interviews with ambassadors indicated that they had successfully participated in a range of events for school students. However, there were issues of confidence, particularly among the younger and less experienced ambassadors. Constraints on ambassadors’ time also presented some issues. Although all ambassadors said their companies supported their ambassador work, their individual ability to negotiate release from work varied a great deal. In general older and more established individuals appeared better placed to get time off.

Time was also a factor in how ambassadors responded to opportunities to participate in different events. Some expressed the preference for pre-organised events as these did not require any extra input in terms of preparation time. Such events, however, appear to present ambassadors with fewer opportunities to introduce new ideas or new materials. Pre-organised STEM days provide a structured and organized context for ambassador activity, but these events could also be daunting and problematic as ambassadors said they were often overstretched during them. In some cases, ambassadors were left in sole charge of large groups and found this difficult and even intimidating. In other cases, ambassadors were so busy providing technical support for activities during events that opportunities to engage with pupils about engineering or challenge preconceived ideas were limited. In these contexts the ambassadors’ function as role models was clearly limited.

Some ambassadors felt question and answer sessions provided the best opportunities for challenging stereotypes and promoting engineering messages though these types of activity only appeared to have taken place in primary school contexts.

How active contract holders were in promoting activities appears to be significant to ambassador engagement and so issues raised about communication across the project may impact on how effectively this is achieved across different regions.

STEM Clubs

The cascade model again appeared to have worked effectively in this strand of the project. Champions successfully raised participants’ awareness of issues of diversity in engineering, sources of information about routes into engineering and raised key messages about engineering. The training sessions seemed effective in enthusing
participants about a range of possible practical activities to undertake with their clubs and in providing them with a first contact to other local club leaders. However, the focus on routes into engineering, engineering messages and local industry were much sharper in these sessions than in the early training observed. While this appeared to be important and eye-opening to some teachers, teachers had little opportunity to engage specifically with the Engineering Ideas Box (EIB). The EIB had been sent to the Champions just before the training when numbers attending training sessions had been confirmed. This meant that at both events the Champions were unable to discuss the contents of the EIB as they were not yet familiar with it themselves. This lack of engagement during training may impact on the likeliness of participants taking up and using these resources.

Interviews and conversations with club leaders and students in schools suggest that the EIB activities and CPD were engaging for students and that students in STEM clubs were aware of the connections between STEM subjects, with many interested in pursuing STEM careers. The EIB activities also encouraged science teachers in particular to develop STEM rather than strictly science-based clubs. The contextualisation of activities appeared to resonate with teachers and was seen as important to engaging students. Activities were being taken up and integrated into existing practice and were being used in the setting up of new clubs or in restarting clubs. Teachers also discussed possibilities of using activities in lessons. Club leaders all discussed continuing to work with the EIB in the future so the project appears to be likely to have a sustainable impact.

One issue, however, appeared to be that the foci of the CPD on diversity issues, engineering messages and engineering careers did not resonate with club leaders’ own priorities. Their primary preoccupation was to identify accessible, engaging, practical resources. At the time of the evaluation, club leaders were not using the diversity, careers and engineering messages resources and it may be that the CPD would have been better focused on the practical activities in the EIB and how to relate these to diversity issues, engineering careers and messages to maximise impact in these areas. Some teachers expressed confusion over how to use the resources and if CPD had focused on activities, the uptake of resources in schools may have been increased as teachers would view them as more accessible. While many of the schools contacted described plans to use the resources in the future, their lack of familiarity with the contents of the box and how it is used may impact on the number using the resources in the future.

Few club leaders were working with STEM ambassadors. It was suggested by key figures at STEMNET that the training of club leaders and STEM ambassadors should have been integrated to encourage club leaders to work with STEM ambassadors in STEM clubs.
Discussion

In bringing together outcomes from all strands of the project, the report concludes that overall the project achieved its aims and was judged by participants to have been successful in providing them with both training they enjoyed and resources which they found useful. Communication emerged as an issue throughout, however, and the lack of continuity of personnel at the centre of the project was widely viewed as disruptive even though the fundamental structure of the project itself was judged to be sound.

The cascade model of training employed by the project was generally seen as successful although sometimes slow to be implemented in practice and at times affected by communications issues at the centre. The need for further funding to extend the reach of the project into more schools was identified by organisers. The development of networks supported by teacher coordinators through another project being led by the Royal Academy of Engineering should, however, support further dissemination.

Another issue that emerged is that the cascade model inevitably meant that the different perspectives and foci of teachers, ambassadors and trainers impacted on messages taken up and practised in schools. Contract holders at STEMNET were focused on their own targets, ambassadors with finding opportunities to visit schools that fitted with their own backgrounds and availability, while teachers were largely concerned to address their own lack of expertise in electronics or teaching D&T, or were looking for enjoyable ‘ready-made’ practical activities for clubs or classrooms. The strategic concerns of the RAEng to promote engineering messages, integrate engineering with other STEM activity and promote diversity in engineering sometimes appeared to be secondary to these other foci. There is a clear need to better link the perceived needs of participants with the strategic aims of the RAEng and to ensure effective communication across the project so that these key messages are not diluted or obscured.

References


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**Foster better education and skills**

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**Promote engineering at the heart of society**

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