Keystage two engineering outreach project

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Abstract
The purpose of this project was to investigate the extent to which engineering concepts could be taught through hands-on activities led by student ambassadors to primary school pupils. The paper describes a programme of activities that was carried out by London South Bank University in local primary schools as part of its outreach programme. The findings show that the primary school pupils associated the concept of engineering, which for some may initially have had a negative connotation, with the notion of a fun and interesting activity. The teaching of science and engineering at primary school level could be enhanced by bringing practical activities which engage all ability levels into the classroom.

Keywords: outreach, under-represented groups, primary education, engineering careers

Background
The project was delivered in primary schools in Southwark and Lambeth. These schools were selected as they had previously taken part in activities organised through the London Engineering Project (LEP) and were identified as containing a large number of black and ethnic minority pupils and those from low socio-economic backgrounds. 158 pupils from four schools took part in the activity. Through problem-based learning and hands-on activities, the project intended to engage pupils in science, technology, engineering and maths (STEM).

Ten student ambassadors from the Faculty of Engineering, Science and the Built Environment at London South Bank University (LSBU) were trained to deliver the project. This consisted of a day’s training specifically around engaging girls and black and ethnic minority students in engineering, on top of two days of training that all student ambassadors receive which covers, amongst other things, diversity awareness, dealing with one’s own prejudices, building trust, child protection and health and safety. Student ambassadors are selected on the basis of their performance against six criteria at an assessment centre. These criteria include communication, diversity awareness, energy and interpersonal skills.

Studies have shown that decisions about careers and progression to higher education (HE) are made relatively early and that the critical age for engaging young people in science and engineering is between the ages of five and 11 (TSO/Office for Standards in Education, 1999).

In Education 3-13, Anne Silver and Brian S. Rushton’s research into primary school pupils’ attitudes to and perceptions of scientists and engineers found that “It is children's stereotypical images of scientists and engineers rather than an actual dislike of science and design technology that dissuades them from becoming scientists and engineers” (Silver and Rushton, 2008).

Rationale
The research quoted above demonstrates that Aimhigher (the previous Government's flagship widening participation initiative), with its focus on 13 to 19 year-olds, was ignoring a fertile ground
for outreach activity. Outreach to younger children lacked funding and focus, and this project provided the university’s Outreach team with the opportunity to put some balance into its programme, particularly as the LEP had already demonstrated that work in primary schools was received enthusiastically by both pupils and their teachers.

Student ambassadors were recruited to deliver the project, as the involvement of school pupils with university students has been shown to enhance the former’s performance and facilitate their progression to higher education (Gartland, 2009). It was also expected that the student ambassadors would gain transferable skills through working with school pupils, as research has shown that the leadership and communication skills of HE students are strongly enhanced through this kind of activity (Ylonen, 2010).

A further purpose of the project was to enthuse primary teachers about using engineering-focused activities in the classroom.

**The approach**

The Keystage Two Engineering Outreach Project was led by the Schools and Colleges Team at LSBU which falls within the Marketing and UK Student Recruitment department. Activities were delivered by student ambassadors from the university’s Faculty of Engineering, Science and the Built Environment.

Staff from the Schools and Colleges Team developed a one-day activity, ‘Professor Georgia’s Engineering Adventures’, which consists of three hands-on activities and an introductory presentation. The session was delivered in four schools.

The session includes:

- Student ambassador-led presentation, ‘An Introduction to Engineering’. This includes information about different types of engineering. Ambassadors introduce themselves and talk about the courses they study or their careers.
- ‘Boing-Boing the Bionic Cat.’ Pupils put together a simple mechanical robotic cat which vibrates and moves around in circles once constructed. The kit is accompanied by a *Boing-Boing the Bionic Cat* book and two worksheets which teachers can use in follow-up sessions.
- ‘Spaghetti Towers.’ Pupils learn about structural engineering by building a tower out of spaghetti and play-doh which must be strong enough to support an egg.
- ‘Pop-Pop Boats.’ Working in teams, pupils construct a boat out of takeaway food containers, copper tubing and a tealight. The copper tube is coiled and filled with water. Once heated by the tealight, the water expands and is pushed out of the tube which in turn propels the boats forwards.

All of the activities were hands-on. The robotic activity required the pupils to work by themselves but the other activities involved working in teams.

According to *Getting Girls into Engineering: a Practical Guide*, “Activities that are put into a societal, environmental or ethical context will instantly engage girls more than ones which are not, without disengaging boys” (The Royal Academy of Engineering, 2010). As the project aimed to engage with girls, activities were developed with this in mind. The sessions focus on the character of ‘Professor Georgia’, which ties the activities together and provides a context for each of the sessions (for example, at the beginning of the ‘Spaghetti Towers’ activity, pupils are given a brief to help Professor Georgia build a tower to house families who have lost their homes in a natural disaster). The idea of the Professor being a female character also aims to challenge gender stereotypes that pupils may have about scientists and engineers.

Staff from the Schools and Colleges Team recruited schools within Southwark and Lambeth. The schools were selected on the basis of intake of children from low socio-economic groups and being feeders to secondary schools with which the university works.
Student ambassadors from the Faculty of Engineering, Science and the Built Environment were recruited to deliver the project and act as experts. 15 student ambassadors were recruited to take part in the activity, more than half of which were female. All of the ambassadors had been through a recruitment and selection process and had attended the LSBU student ambassador training (this included sessions on communication, diversity awareness, creating a rapport, health and safety and child protection). In addition, these ambassadors attended STEM outreach training (which covered gender and diversity awareness and how to run STEM activities). All students had previous experience of working with young people and delivering activities. Working with student ambassadors gave pupils the opportunity to ask general questions about university and student life and also about specific engineering courses. The ambassadors were paid for their involvement in the project.

The project also aimed to equip student ambassadors with transferable skills that would make them more employable. It was hoped that, through leading and delivering the project, they would develop their interpersonal, leadership and teamwork skills.

Some sessions were attended by Science, Technology, Engineering and Mathematics Network (STEMNET) STEM Ambassadors. This helped to demonstrate to pupils the link between HE and graduate careers in engineering.

Teachers were provided with worksheets, tied into the ‘Boing-Boing’ activity, which they were able to use in subsequent sessions.

**Assessment**

The hands-on element of this project meant that school pupils were given an opportunity to be creative, gain a sense of accomplishment on completing the project, hear about what engineers do and engage in practical challenges and thinking activities which are characteristic of engineering practice.

The student ambassadors that delivered the project had the opportunity to develop communication skills which will make them more effective employees.

**Evaluation**

158 pupils from four schools took part in the project. They were asked to fill in evaluation forms at the end of sessions. Feedback was excellent; the majority of the pupils had not only enjoyed the day, but had also developed an increased understanding of STEM (see Figure 1).

![Figure 1. Summary of pupil feedback](image)

The pupils were asked which of the sessions that they liked the best. Answers to this question were mixed, with no single activity standing out as the most enjoyable. Many of the pupils answered “everything” to this question.

The pupils were from mixed ethnic backgrounds and, because the teachers had selected class groups, there was an equal split in terms of male and female pupils.
The project received positive feedback from teachers. Ms Henrietta Cole of Hollydale School commented that "The pupils really enjoyed the session and found it challenging but in a positive and enjoyable way." The teachers also found that the workbooks that accompanied the activities were helpful: "They were very useful and created a link between the activity and the purpose of the activity", said Ms Cole. They also felt that the workbooks gave them a chance to follow up the sessions.

All of the teachers agreed that it was useful for the pupils to interact with student ambassadors. They said that the ambassadors were great role models in terms of promoting STEM and HE and that they were also able to facilitate the activities.

One of the most interesting pieces of feedback was from a teacher at Friars Primary school who commented that the best thing about the day was that it was suited to all learning styles, thus all of the pupils could take something away from the session. This was a goal-free added-value outcome of the project.

Another unexpected benefit of the session was that a teacher at one school followed it up with a writing exercise where all of the pupils sent letters of thanks to the Schools and Colleges Team and ambassadors.

The project received good feedback from the student ambassadors. One states that "The activities are so much fun and therefore the pupils associate engineering and science with things that are interesting rather than as difficult and something that they don’t want to do." Some of the ambassadors also commented that it was easier to keep the pupils engaged because the activities were short.

Many of the ambassadors felt that the sessions had also strengthened their employability skills, particularly their communication skills. One ambassador said: "Working with primary school pupils is a real challenge; you have to explain everything very clearly and keep them engaged." Others said that it gave them an opportunity to practice their presentation skills.

Discussion, summary

Overall, the session received great feedback and was successful in engaging pupils and informing them about STEM. The project also proved to be successful in helping to enhance student ambassadors’ employability skills, most notably in terms of communication and presentation skills.

The project coordinators had originally planned to run eight sessions, but it proved difficult to recruit this many schools. This was due in part to the fact that many teachers were not able to fit the session into their timetables and also because sessions had to be planned around the student ambassadors’ exam and coursework periods. Instead, the team worked with more than one class in some schools.

The Schools and Colleges Team had planned to revisit schools in 2012, invite pupils to the university and run a follow-up evaluation. Unfortunately, due to the ending of Aimhigher funding, the team lost one member of staff and for this reason it wasn’t possible to do so.

Further development

The project is scalable and portable to other schools.

With further time and funding, the pupils that were involved in the project could be tracked in order to find out whether they go on to further and higher education engineering courses.

One teacher commented that she would like to run some of the activities herself but would need extra training and resources. A CPD could be delivered by the Schools and Colleges Team for those teachers that are interested.

In future, this project could be used to research issues surrounding gender and STEM subjects (for example, whether mixed teams or all-girl/all-boy teams work better together).
References


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