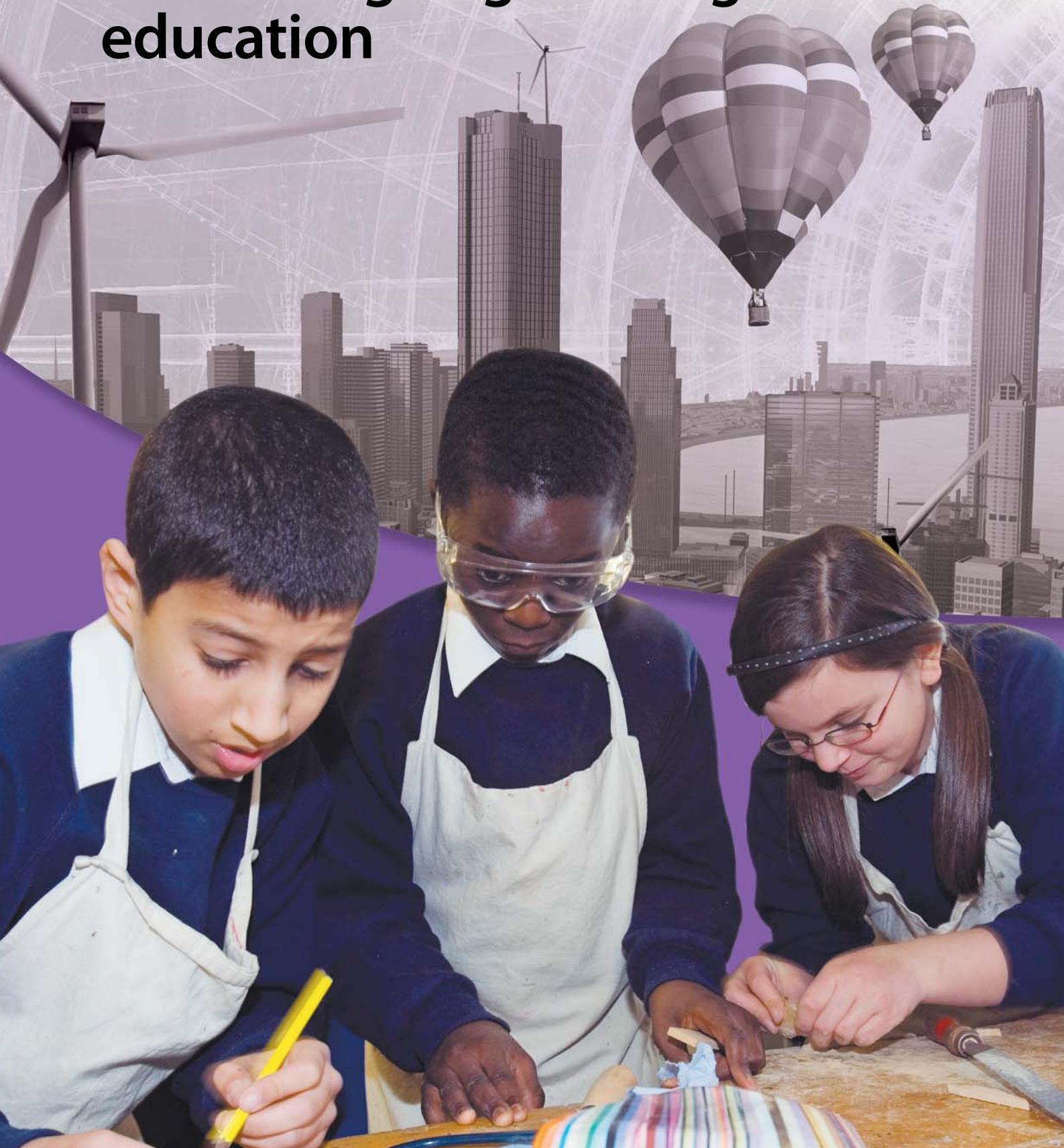


LONDON
ENGINEERING
PROJECT

HIGHER EDUCATION *hefce*
FUNDING COUNCIL FOR ENGLAND

Pioneering engineering education



Introduction

Increasing the number of UK-grown engineers and scientists is pivotal to the continued wealth and health of our country, and the wider world.

Engineers and scientists are the people who will slow down global warming, deal with its current and future effects and develop carbon-neutral fuels to ensure the continuation of our planet.

They will develop new treatments for previously life-threatening or debilitating diseases, ways of increasing food production and ways of supplying developing nations with clean, safe drinking water.

However, we are facing a shortage of these skilled individuals. Although participation in higher education has grown by some 60% in the last 10 years, the number of students taking engineering degrees has remained static. Women still make up only 14% of engineering undergraduates and students from some socio-economic groups remain deeply under-represented.

To increase the numbers of engineers, we need everyone to consider engineering as a career.

In the summer of 2005, HEFCE awarded The Royal Academy of Engineering and its partners £2.82m to launch the first phase of the London Engineering Project (LEP). The Project has been a determined attempt to widen participation in engineering higher education (HE). It is also a pilot project that has brought a partnership of national organisations and some 50 London schools together to get more women, more black and minority ethnic (BME) students and more students from families with no previous footprint in HE to opt for engineering degree courses. People from these groups are among the most under represented in engineering higher education, and their participation is vital if we are to see the number of engineers increase to meet the increasing national and international demand.

To this end, the LEP has worked in schools and colleges to stimulate interest in engineering as a career and thereby increase demand for engineering degree courses.

In universities, it has worked in engineering departments enhancing degree courses and developing models for improved student learning experiences to make engineering more attractive to prospective undergraduates.

The first phase of the LEP concluded in March 2008, and this review is an illustration of the work and achievements of the Project to that point.

And it has worked.

South and East London schools have engineering firmly placed within their student offering. The new Diploma in Engineering for 14-19 year old students will supply a natural progression path, and the LEP HEIs are providing enhanced, modern engineering degree courses.

The scene is set in London to see an increase in engineering undergraduates.

In schools



The Project has worked with 50 schools and produced 20,000 student contact days in the London Boroughs of Southwark, Lambeth, Lewisham, Tower Hamlets and Newham. These include wards that are amongst the most deprived in England and where participation rates in higher education are amongst the lowest.

New organisational tools were developed for the Project and 12 full-time and part-time fieldworkers were employed by 7 of the partner organisations. Tools developed and implemented include:

- A process to drive equality and inclusion into every aspect of the project and become a model of best practice
- Both qualitative and quantitative measures for impact evaluation
- A coordinated system for event planning and administration
- A set of service level agreements linking scorecard performance metrics to financial support

These provided an efficient platform from which a complex set of Project activities could be delivered, including:

- STEM (science, technology, engineering, maths) project days in primary schools
- After school science and engineering clubs in primary and secondary schools
- STEM learning days in secondary schools
- Taster events in secondary schools
- Role models and engineering ambassadors in schools
- E-mentoring
- Residential courses in engineering
- Engineering summer schools
- Science and engineering competitions

Oliver Goldsmith Primary School

Case Study

Oliver Goldsmith Primary School in Southwark has three aims based around achievement, citizenship and equal opportunities: to provide a broad, balanced and relevant curriculum for all children which will raise achievement and release potential, academically, aesthetically and spiritually; to develop in all children a responsible and independent attitude towards work in preparation for their roles in society; and to provide an environment of tolerance, understanding and respect in which all children can flourish and have confidence to challenge inequality.

The school treasures its cultural diversity and encourages its pupils to take full advantage of the educational opportunities it offers them, nurturing in them the confidence to take responsibility for their own learning and reach their full potential.

It has been involved with the London Engineering Project since its inception two years ago and as a result now has a 36-strong after school Science and Engineering Club for Year 6 students. Led by the school's Science Coordinator, Hedney Gordon, every Thursday afternoon the children work in groups to solve the problems set for them yet are under no pressure to record anything on paper, making it both a fun and a worthwhile learning experience.

Hedney has shared the club's activities with the whole school through running a Science and Engineering Week. The older pupils demonstrated what they had been doing on club days, and the younger pupils were encouraged to have a go at some of

the activities, which has built up their confidence and forged mentoring relationships between the older and younger students. Many of the younger pupils are already expressing an interest in joining the club when they are old enough.

As a result of being involved with the LEP and the hands-on activities it offers, the school has been able to improve its delivery of investigative and practical science; areas where it felt it could improve.

Hedney says,

"I have found running the club really beneficial for honing my own skills as Science Coordinator. We have 36 children coming to the after-school club, and even some of the Year 7s who attended last year's club are coming back to help out. The club has been so popular that I would like to introduce activities for Years 4 and 5 too."



In universities



To date, the Project has worked with:

- **The Faculty of Engineering, Science and the Built Environment at London South Bank University (LSBU)**
- **The Department of Mechanical Engineering at University College London (UCL)**
- **The Department of Engineering at the University of Sussex**

These three engineering departments were chosen carefully to represent the diverse spectrum of engineering departments in the UK; from those that seek to recruit as many students as practicable to those that must select a limited number of students each year.

At LSBU, the project has concentrated on managing the transition from school or college, through university and into employment for students from under-represented groups. This has been sought in three ways:

- **Through an engineering outreach programme which goes into local schools**
- **Through the development of a *transitions to higher education* checklist offering practical advice to departments and courses in the faculty**
- **Through the development of a Foundation Degree in Engineering Infrastructure as a ladder into engineering higher education**

At the University of Sussex, the Project has concentrated on the development of a new 3-year degree course, *Engineering for Society*, which fuses engineering with developmental and environmental studies. The course attracts twice as many applications from women than more traditional engineering courses.

At UCL, the Project has concentrated on enhancing existing courses for the students. A number of new project strands have been developed, including:

- **A team-based learning project which has paid dividends in terms of student experience and learning outcomes**
- **A revised method for supporting first year students in developing the required mathematical skills**
- **Weblabs as a means of building student engagement with practical elements of the course**

Central Foundation School for Girls Case Study

Central Foundation Girls' School is an exciting place to work and learn. It is a large and inclusive 11 to 18 inner-city girls' school in Bow, East London.

The school has two specialist strands: performing arts and citizenship, and it prides itself on enabling tomorrow's women to achieve academic excellence and self fulfillment, encouraging their development as leaders, champions of environmental sustainability and active citizens. The ethnic, linguistic and cultural diversity of the school's community is a great strength, and it actively promotes equality of opportunity.

Head of Design and Technology at the school is Colin O'Donnell.

Colin believes that working with outside organisations like the London Engineering Project is extremely important. It enables his students to learn in an environment away from the classroom and brings an extra dimension to his subject of Resistant Materials (RM). He also wanted to challenge the stereotype image of RM being a subject that is more for boys than girls, and the extra activities offered by the LEP have enabled him to do just that.

Colin has focused his LEP activities on students in Years 9 and 10.



He says,

"I have taken Year 9 on LEP Smallpeice Trust STEM days and to their Trebuchet challenge; activities that they all enjoyed. For the older Year 10 students, I use the LEP's expertise to get them really interested in and focused on possible access to engineering-type careers."



With this in mind, Colin took 20 girls from his Year 10 Resistant Materials class to the LEP residential course at Harper Adams University and is hoping to permanently build this into his class in the future.

His pupils also attended an IStructE Challenge day where one of his groups won first prize. They attended an Engineering Islam event at London South Bank University too and have been visited in school by the LEP team who delivered their wind tower activity; an activity in which eco-minded pupils design and construct an efficient wind turbine to convert wind power into electricity and are encouraged to discuss the many different renewable energy sources available and why wind power is now being used more and more in Britain.

Working with the LEP has helped Colin achieve his aims for the school. Resistant Materials is now a very popular subject at Key Stage 4 and the students have become interested in pursuing engineering-type careers, understanding that RM as a subject and engineering and technology careers can be as suitable and as rewarding for girls as well as boys.

Colin adds,

"In school, my subject has progressed rapidly. Within the last two years we have begun running two optional classes of Resistant Materials at Key Stage 4 and plan to set up a post-16 option in 2009-2010. The girls have thoroughly enjoyed their LEP involvement and this has aided and reinforced the popularity of Resistant Materials.

Stereotypes are being broken down and Resistant Materials is now being seen as a subject for girls as well as boys. This can only benefit the students and give them an understanding of the role they could play in the future of engineering."

UCL students talk

What was the problem with team work?

In the 4th year of our Masters degree we do a group project. Up until then we don't do much group work, and it can be really difficult dealing with the engineering problem in a team situation. The problem might be something like building a formula one racing car or a remote-controlled powered boat, and we have to do it together so have to learn to deal with delegation, conflict-negotiation and innovation within the team. If the team members don't work well together the project can fail, so we needed some extra guidance on team building and team working.

What did the LEP do to help?

The LEP Education Innovator implemented a once-weekly session on team building that was added to the student timetable. It focused on generic team building skills and issues of team working, and towards the end of the third term developed into how to use the skills during assessments and even incorporate knowledge of them into job applications. UCL didn't have a staff member who could teach this unit, so The Royal Academy of Engineering even provided the visiting lecturer to teach the course.

What was the problem with careers advice?

We felt that we didn't get much contact with recently graduated, working engineers. We wanted to hear from people just a few years ahead of us on the career path to see how they had advanced their careers. Some of us only knew about graduate recruitment schemes as a way of getting a job after university, and we wanted to hear about other options open to us and what to expect at interviews. We also wanted some honest accounts of what it is really like working as an engineer; the good and the bad.

What did the LEP do to help?

The LEP added a once-weekly session to the timetable that brought in a young external lecturer to talk about what they had done with their career and answer our questions. We had talks from entrepreneurs, recent graduates on graduate schemes, others who had chosen not to take that route and engineers at various stages towards their Chartered status. We heard from employees of all different sorts of companies, from large multinationals to SMEs.



Little Ilford School

Case Study

Little Ilford School is a large comprehensive school in Manor Park, Newham with over 1,300 pupils aged 11 to 16. The school has been working with the London Engineering Project for over a year and has been involved in the majority of activities offered in school and externally. These include the Engineering Islam event, the IStructE Challenge, the Trebuchet Challenge and its grand-finale at the House of Commons. From the various challenges to the STEM days and Year 7 taster days, Little Ilford has always been there in force. Also popular with Little Ilford pupils have been the yearly Smallpeice Trust residential courses run for Years 9, 10 and 11 students. These residential courses have even been incorporated into the school's science teaching, and the feedback from the students is that the course activities have helped them to understand difficult science concepts.



Year 10 student, Masum Hussain, says,

“During my time on the residential course, I made new friends and also learnt a great deal. I hope to attend many more in the future!”

Abu Bakar, a Year 10 student who recently attended an electronics STEM day at LSBU says,

“The visit to London South Bank University was an adventure. I admired the way the lecturers teach over there, and the way they help the students with their projects. This type of educational visit is very beneficial for young students and for young, aspiring engineers who want to become a successful engineer in the future.”



“Joining the LEP has enabled our students to incorporate their curricular skills into practical tasks as well as becoming independent learners. They also got the chance to learn about career choices and help with planning their futures,” says Famida Noor-Mahomed, a teacher at the school.

“Many of our students would not have had the opportunities provided by the LEP like the engineering club and the various activity days. The students have become more confident as a result of their LEP experiences and their interaction with LEP staff and the older students at London South Bank University. They are more positive about the future and have realised that a great career is possible and available to them.

“The LEP programme has also helped us as a school to plan for future activities and we have plans to create an introduction to engineering for new pupils joining Year 7. It has also added a beneficial new dimension to the school which has historically been focused on literacy.”

Little Ilford found their LEP experience involved a steep learning curve and believes that some new schools joining the LEP would benefit from existing LEP schools passing on their knowledge and expertise.

“We would welcome the opportunity to pass on our experiences and believe that not only would it keep the legacy of the LEP alive, but also encourage students from different backgrounds to mix and excel,” ends Famida.

UCL staff talk

What was the problem with maths?

We were finding that some students were struggling with our compulsory first year maths module, even with a good A level in the subject. The module is designed to not only teach the basic mathematical tools for engineering, but also the applications of each topic to put them into a real context. Not all our students were achieving the required standard and this was having a detrimental effect on student progression and retention.

What did the LEP do to help?

The LEP assisted a new support strategy which has now been running for two years.

Revision lectures were introduced for all the students to enable them to brush up on their A level skills after the long summer vacation (and in some cases, gap year).

In addition, before starting university, the students are being encouraged to hone their maths skills. A 'revision pack' was developed for them to go through prior to their arrival containing a set of worked examples of mathematics that they will encounter in their first term plus sets of questions to attempt. Feedback from the students about the revision packs has been very positive. They feel better prepared and more confident about their personal mathematical abilities when they arrive, and this has had a positive effect on their early university experience. The revision packs have been so well received, that the university plans to continue using them indefinitely.

Research was also carried out as to the best way to deliver the maths course to the first year students, with booster sessions for some students being trialled for a short period.

As a result, the students are now divided into two differently taught classes, but all students cover the same material and sit the same assessment papers and end of year exam. This streaming of the students and altering of the teaching style has proved a successful method of supporting the mathematically weaker students.

What was the problem with practical work?

We found that we didn't always have enough lab-time, because there was simply not enough to go round. We were doing a 'lab' in vibrations and waves, and some students wanted extra lab-time to improve their understanding but couldn't have it. Others had to miss out altogether because they had to respect religious holidays and couldn't reschedule.

What did the LEP do to help?

The academic staff at the university developed a 'virtual lab' for us, and the LEP paid for it. We can access it online from our own computers and run experiments in real time. Our results are sent to us via email and we can even have a video clip of our work. It means that we can repeat an experiment as often as we want to, change variables to see what happens and watch it over and over.



LEP employers

From the beginning, London employers were sought who were prepared to work with the LEP; employers who would look to the schools for future employees.

Many employers engaged with the Project and continue to provide support; both financial and in-kind.

- **Thames Water was the first employer to make a contribution, supplying an environmental learning activity for schools, contributing to the development of the Foundation Degree in Engineering Infrastructure at LSBU and critically, through their mere presence, stimulating interest from other employers**
- **EDF Energy has provided a backbone of financial and practical help to establish the Foundation Degree in Engineering Infrastructure**
- **Transport for London has provided funding for the production of learning resources and a steady supply of engineering ambassadors and role models**
- **50 small and medium sized employers in London responded to a Project media campaign to recruit more black and Asian engineering role models for work in schools**
- **Tube Lines has launched its own Ambassadors Scheme, modelled on the LEP's own (taking full advantage of STEMNET's Science and Engineering Ambassadors scheme for training and coordination) to provide both LEP schools and local schools delivering the 14-19 Diploma in Engineering a supply of role models, mentors, ambassadors and teacher supporters**

This employer engagement is becoming embedded in LEP schools and looks set to continue well beyond the life of the project.

St Saviour's and St Olave's School for Girls Case Study



With the school motto, 'Heirs of the Past, Children of the Present, Makers of the Future', St Saviour's and St Olave's School for Girls understands that every student has the right to equality of opportunity and respect for their own ethnic, cultural and religious background. With an ethos based on mutual respect and care, the school works to give its students the confidence to achieve to their maximum potential and equip them with the skills and knowledge needed to contribute positively and responsibly to future society.

The school became a member of the London Engineering Project back in April 2007 and since then has been involved in virtually every LEP event organised.

Students have attended a four-day residential engineering course at Harper Adams University, taken part in the widely publicised Engineering Islam Day at London South Bank University, the Trebuchet Challenge at the Tower of London, and on top of all that, also runs a very successful after school Young Engineers Club with regular weekly meetings.

Masabie Cassell, Amisha Patel, Jemma O'Sullivan and Holly Mason from Year 9 are all members of their Young Engineers Club. They have all taken part in competitions and challenges run through the LEP and explain what it has meant for them.

"During our club sessions we have been working through the Young Engineers activities booklet doing activities like 'Marble Run' and 'Elastic Band Buggies'. We have also built aircrafts for the Airbus Project Eggs Factor challenge. At the moment we are working on our Greenpower car to hopefully have it ready for the regional finals. We visited Goodwood Motor Circuit with the LEP to watch this year's Greenpower Final to see what other schools have done with their cars, and it gave us lots of good ideas for ours. We also took part in the Young Engineers K'Nex Tallest Tower competition which Ebony Ebanks from our school won."

"Our club represented London at the national Young Engineers Awards in Greenwich. We travelled to the Old Naval College to showcase all the projects, activities and challenges we have worked on since starting our club. It was a real privilege just to be one of eight secondary schools nominated."

"We visited the Royal Navy ship, HMS Exeter, at the London Boat Show too. We had an exclusive guided tour of the ship and got to see areas that were not open to the public. It was a once in a lifetime experience."

"All the activities we have been able to do with the LEP have definitely made us consider being engineers in the future."

The Future

The London Engineering Project will continue as a pilot in London until July 2009. Thereafter, plans are in place for a national rollout of the Project conjoined with its sister projects in maths, physics and chemistry.

In London, the Project will leave a lasting legacy.

South and East London schools now have engineering embedded into their teaching with the London Engineering Project being mentioned in some participating schools' OFSTED reports.

The Ambassadors scheme inaugurated by Tube Lines and TFL to complement the LEP Ambassadors scheme already in place will continue to function, with professional engineers from these London

companies continuing to inspire youngsters in London schools.

The new Engineering Diploma for 14-19 year old students will take engineering education in schools on to the next level. Piloted in September 2008 in Lambeth and Southwark, many of the pilot schools are also LEP schools so are well placed to incorporate the new curricula into their student offering.

LEP HEIs will continue to offer their new or enhanced degree courses, employing the improved teaching methods and tools inaugurated as a result of LEP support. The innovative new teaching methods employed will be disseminated as a model of best practice to enable other HEIs to benefit from them.



The LEP is a Partnership led and managed by The Royal Academy of Engineering with the generous support of the Higher Education Funding Council for England (HEFCE).

The partners in London Engineering Project are:

- The Royal Academy of Engineering
- London South Bank University
- The Brightside Trust
- The British Association for the Advancement of Science
- Cambridge-MIT Institute
- EDF Energy
- The Engineering Professors' Council
- HEFCE
- The Higher Education Academy Engineering Subject Centre
- RWE Thames Water
- STEMNET
- The Smallpeice Trust
- Transport for London
- The UK Resource Centre for Women in Science, Engineering and Technology
- University College London
- The University of Sussex
- Young Engineers

LEP Partners

The Royal Academy of Engineering

As Britain's national academy for engineering, we bring together the country's most eminent engineers from all disciplines to promote excellence in the science, art and practice of engineering. Our strategic priorities are to enhance the UK's engineering capabilities, to celebrate excellence and inspire the next generation, and to lead debate by guiding informed thinking and influencing public policy.

The Academy's work programmes are driven by three strategic priorities, each of which provides a key contribution to a strong and vibrant engineering sector and to the health and wealth of society.

Enhancing national capabilities

As a priority, we encourage, support and facilitate links between academia and industry. Through targeted national and international programmes, we enhance – and reflect abroad – the UK's performance in the application of science, technology transfer, and the promotion and exploitation of innovation. We support high quality engineering research, encourage an interdisciplinary ethos, facilitate international exchange and provide a means of determining and disseminating best practice. In particular, our activities focus on complex and multidisciplinary areas of rapid development.

Recognising excellence and inspiring the next generation

Excellence breeds excellence. We celebrate engineering excellence and use it to inspire, support and challenge tomorrow's engineering leaders. We focus our initiatives to develop excellence and, through creative and collaborative activity, we demonstrate to the young, and those who influence them, the relevance of engineering to society.

Leading debate

Using the leadership and expertise of our Fellowship, we guide informed thinking, influence public policy making, provide a forum for the mutual exchange of ideas, and pursue effective engagement with society on matters within our competence. The Academy advocates progressive, forward-looking solutions based on impartial advice and quality foundations, and works to enhance appreciation of the positive role of engineering and its contribution to the economic strength of the nation.



The Royal Academy
of Engineering

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