Building the capacity of engineering lecturers to take part in engineering outreach from HEIs in the Midlands & East Anglia region

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Abstract
This project was undertaken to encourage engineering lecturers to engage with or lead engineering outreach within their Higher Education Institution (HEI). The project was undertaken in two stages. The first stage looked at existing success within the regional HEIs to identify effective practice, current motivators and to capture the baseline status of outreach. The second stage involved the development, piloting and rollout of an outreach support package and resource pack that could be used in all HEIs. Ultimately the HEIs themselves would deliver outreach activities to schools and colleges. The project involved a number of HEIs within the region as well as other organisations such as STEMNET, local Education Business Partnerships (EBPs) and relevant commercial organisations. As well as the outreach support pack and staff development resource pack, tangible project outcomes include an increased number of trained and registered STEM Ambassadors and a greater level of outreach delivery.

Keywords: engineering, outreach, HEI, student recruitment, STEM Ambassadors, engineering, widening participation

Background
The project was initially aimed at engineering lecturers within several Higher Education Institutions (HEIs) within the Midlands and East Anglia region, where there are a number of HEIs delivering engineering outreach that find it hard to engage lecturers in the design and delivery of outreach activities and events. The scope of the project was widened in the initial stages to include postdoctoral research fellows, research assistants and postgraduate research students.

This project was built on the learning from the London Engineering Project (LEP). The LEP was a partnership of schools, colleges, universities, science and engineering education charities, industry and Government, whose aim was to create more people with engineering skills in the capital. The LEP also aimed to create a route that takes students from school, through further education (FE) and higher education (HE) into the profession. A particular focus of the LEP was to persuade more young students from London to choose engineering careers, and sought to engage women and to engage students from Caribbean, Bangladeshi and Pakistani backgrounds, all of whom are currently under-represented in engineering. This was achieved by providing inspiring outreach activities in schools and developing attractive and relevant engineering courses in universities in London that were populated with students from London schools and FE colleges.

Engineering employers played a significant role in the development of the engineering courses and the promotion of engineering as a career option to students in schools and colleges. The outreach activities were delivered using student ambassadors, professional engineers and STEM Ambassadors. The LEP worked to engage engineering lecturers with limited success;
consequently the National HE STEM Programme wanted to further explore how HEIs can engage engineering lecturers in outreach.

Rationale

There are two main objectives that the project hoped to achieve. First, the project aimed to find out how academics already engage with and develop outreach activities within HEIs. Second, the project wanted to understand how more academics could be encouraged to get involved in outreach and improve existing outreach programmes within HEIs.

Research by Cater and Griffiths (2012), which became available at the time of writing, supports the rationale for the project and the need to increase the number of school and FE college students to study STEM subjects as a possible step towards choosing engineering as a career option, and examined how the work of the Welsh Engineering Project (WEP) and the Engineering Education Scheme in Wales (EESW) could be extended and add value to outreach to increase interest in engineering. Three portfolios of activities were used for outreach: one for primary schools, one for girls in secondary schools, and one for sixth form outreach. Whilst the project was deemed to have been successful, it was noted that work was still required to promote engineering as a career, and the need to foster links with primary and secondary schools was also highlighted.

Hawthorne et al. (2009a) and Gartland, Hawthorne and McLoughlin (2010) investigated the use of undergraduate student ambassadors for the delivery of outreach. Through the LEP, London South Bank University (LSBU) provided student ambassadors with extended training to allow them to undertake outreach and engage with secondary schools involved with the LEP, as research suggested that younger students in schools are influenced more by ‘hot’ sources of information, such as family members and their peer group, than official sources. Student ambassadors were selected according to their ability to act as role models for younger students and their ability to be seen as aspirational figures for younger students. The student ambassadors received training in delivering outreach alongside training in gender and racial awareness and inclusion. The student ambassadors were observed to consciously promote STEM, and this was embedded due to the positive working relationships developed between ambassadors and younger students.

Student ambassadors are also involved, alongside professional engineers, in the work undertaken by Hawthorne et al. (2009b) in developing and delivering outreach that promoted engineering as a potential future career at schools involved with the LEP. STEM Ambassadors directly supported LEP activities by supporting creative activities, by offering expert engineering advice and by working with the teams on the more hands-on activities. All the activities developed under the auspices of the LEP were embedded with an engineering message to contextualise engineering and emphasise the impact engineering has in the world and the choices people are able to make.

Approach

Initially there were ten HEIs from the Midlands and East Anglia region participating in the project. However over the course of the project the number of engaged HEIs reduced to six. The overall aim of the project was to develop a strategy for engaging engineering lecturers in more engineering outreach in the region that incorporated a transfer of the successful aspects of the LEP into the region. This was achieved through the following approach:

- A working group was established to design and develop a program for engaging engineering academics in engineering outreach. This included capturing existing effective practice, a research study and further discussion, leading to the creation of a pilot outline and programme for a formal training day (including advice on how to sign up lecturers up as STEM Ambassadors to the National STEM Ambassadors scheme managed by STEMNET via the STEM Ambassadors contract holders within each region).
- Consultation in each participating HEI with academics to establish a baseline evaluation for the project regarding the motivations of academics in getting involved with outreach. This helped project partners to understand the current motivations of academic staff in getting involved with engineering outreach within their own HEI and what put them off getting involved.
- The development of an outreach support package that could be incorporated into the
Postgraduate Certificate in Higher Education qualification for probationary lecturers. This would not exclude other engineering lecturers and researchers from taking part.

- The piloting of the outreach support package at each HEI involved in the project.
- The engagement of lecturers in the delivery of outreach to schools and colleges.
- Working with STEMNET to promote outreach and STEM Clubs to schools and colleges.

The role of the representatives from the participating HEIs was to ensure that the requirements of the project were delivered at their respective HEIs and to report back to the project lead with regards to progress in project delivery. Initial targets for the project included engaging at least ten lecturers per HEI in a focus group, the delivery of one training session per HEI per year of the project, and the registration of ten lecturers per HEI as STEM Ambassadors.

The working group for the project held its first meeting in October 2010. In addition to HEI representatives, representatives from STEMNET attended to provide input and insight from the perspective of schools and colleges. Representatives from Thinktank also attended as they would develop the outreach support package and resource pack.

The group felt that an online questionnaire would be more suited to collating the required information to establish a baseline evaluation. The questionnaire incorporated the following points:

- Whether respondents and HEIs were currently involved in outreach.
- Who already acted as a STEM Ambassador.
- Health and Safety requirements in the classroom.
- Awareness of the different types of learners.
- CRB and child protection issues.
- Objectives and facilitation of the training materials, skills and resources.

The questionnaire was circulated to engineering academics at participating HEIs, and the results were passed to Thinktank for the development of the outreach package and resource pack. It was agreed that an online virtual resource that is readily accessible by academics willing to undertake outreach would be more appropriate. It was also agreed to hold two regional training events to introduce the online resource to the HEIs, as this would allow colleagues across the HEIs to share existing practice in relation to outreach.

The training days were divided into two separate sessions. The first session covered Public Engagement (PE) Training to enable academics to deliver outreach, and included the following:

- Overview of the training resource.
- Activity development process and evaluation of the activity development process.
- STEM Ambassador Programme.
- Sharing activity ideas: which activities work well and which activities do not.
- How to deal with the activity going wrong.

The second session covered “Training The Trainer” (TTT), for academics who would be delivering the PE training at their respective HEIs, and addressed the following:

- Thinking about potential audiences.
- Setting objectives for the PE Training.
- Top planning tips: environment, how to overcome blocking behaviours, logistics.

The two training days took place during July 2011 at Thinktank in Birmingham and the East Midlands Conference Centre (EMCC) in Nottingham. A total of 29 academics and postgraduate students from the partner HEIs attended these sessions. It was suggested that the online resource be placed on the National HE STEM Programme website and the Royal Academy of Engineering website, as well as on the websites and virtual learning environments (VLEs) of partner HEIs.

**Evaluation**

Engagement targets have only partially been achieved for the project. Out of the ten regional HEIs who agreed to participate in the project, only six of those HEIs actively engaged and participated in activities, despite regular, consistent and constant communication with the ten HEIs. Seventy academics responded to the baseline evaluation questionnaire, thirty responses less than the
involvement of one hundred academics that was originally targeted. However if this figure is averaged over the six HEIs that participated, a response rate of more than ten academics per HEI is achieved.

The 29 academics and postgraduate students who attended the training days provided a lower figure than the ten lecturers per HEI to whom it had been intended to deliver the training session. However two regional training days had been held in place of the proposed training session per HEI during the first year of the project. Taking into account that only six HEIs were engaging at this stage of the project, there would still have been an expectation of 60 academics and postgraduate students attending the training sessions. The counter argument to the low figure would be whether a training session with an average of 30 attendees would have been as productive as a training session with an average of 15 attendees, given the activities involved in the training session and the training sessions being designed to account for small numbers. Currently there is no data as to whether academics have signed up as STEM Ambassadors as a result of the training session.

The first part of the evaluation considered the responses to the questionnaire used to determine the baseline evaluation for the project. The closed questions produced the following responses:

- 81% of respondents were aware of what STEM is
- 86% were aware of what outreach is.
- 62% were aware that STEM activities were taking place.
- 55% were not aware of what a STEM Ambassador is, or what a STEM Ambassador does.
- 62% did not know where to find information to undertake outreach activities.
- 61% did not, at that point in time, undertake outreach activities with schools or colleges.
- For respondents who did undertake outreach, 91% delivered activities at their HEIs, 52% delivered activities at schools and colleges, and 29% delivered activities at other sites.
- 60% were aware of Health and Safety requirements for delivering outreach in classrooms.
- 58% would not know how to evaluate what is happening in the classroom during outreach activities in primary and secondary schools.
- 85% were aware of the CRB (Criminal Record Bureau) checks required and child protection issues for undertaking outreach activities in primary and secondary schools.
- 68% were not aware of what their HEI's target or priority group would be for outreach.
- 96% did not know how to begin doing outreach work.
- 87% did not know the correct departments to speak with to begin outreach work.
- 54% were not aware of the National STEM Ambassadors Programme.
- 92% were not STEM Ambassadors.

For the question “What outreach do you currently deliver or have done in the past?” respondents who had previously undertaken outreach activities produced detailed responses:

"I run a series of Engineering Masterclasses [sic]. School children attend university for a day, and participate in engineering related activities (usually very practical)."

"Related to Formula Student project but to address local school request."

When asked; "What support would you like in place to be able to improve your outreach or do more?” responses included the request for finance, time and standard evaluation. For the questions “What additional skills do you think you would need for undertaking outreach activities in primary schools?”, “What additional skills do you think you would need for undertaking outreach activities in secondary schools?” and “What additional skills do you think you would need for undertaking outreach activities in FE colleges?” responses included knowledge of the respective curricula. The question “How would you like to see the training package structured?” produced responses that expressed a preference for an online resource.

Respondents who were STEM Ambassadors, gave reasons for becoming ambassadors, including the following:

"Administration taken care of, including CRB."
“Have been doing this sort of activity since I left school and used the scheme to formalise my engagement, e.g. insurance and CRB checks.”

However, reasons for not being a STEM Ambassador outweighed reasons in favour:

“We already have a number of faculty staff who are currently active Ambassadors.”

“Within a busy workload, this has not been a priority. It may however become an area that I need to give greater attention to.”

“I am afraid I am committing to something that at some point will be too much for me.”

The second part to the evaluation considered the reaction to the support package and the two training days that were held to introduce the package. In relation to the Public Engagement (PE) Training, the evaluation from the first training day was overwhelmingly positive. Attendees felt that the training day and the package had addressed the concerns that they had raised. In general terms, the attendees felt more confident and more aware of the support available to them as a result of attending the training day:

“A helpful event that has allowed me to focus on PE and motivated me to explore getting more involved. Visibility is an issue and something I need to address back home.”

“The activity during the training was very useful and thought provoking, providing an insight into how useful such activities are.”

The evaluations received at the end of the second day were equivalent to those on the first day, with the exception of one element relating to registration as a STEM Ambassador. At the first training day a majority of attendees stated that they would be registering as a STEM Ambassador, whilst at the second training only one attendee stated that they would register as an Ambassador. This might have been due to the presence of a representative of STEMNET at the first training day. Comments from the second training day included the following:

“It was a very well planned event with relevant activities.”

“Well delivered, as an exercise in engagement it was very well deployed/delivered.”

In relation to the Train The Trainer (TTT) Training, the evaluation following the first training day suggested that the participants were not very confident in delivering public engagement training at the start of the day but that they felt more confident and skilled by the end of the day and that delivering training would be of personal and professional benefit to them:

“Before I came here I wasn't confident in my own authority in training others but now I am.”

“Advice on how to deal with blocking behaviours was very useful.”

An internal review at Thinktank found that the TTT session would benefit from more interactivity and engagement. Therefore the session was restructured to change some of the elements into activities that were more engaging for the participants, whilst preserving the overall structure of the session. As a result of these changes and taking into consideration that it was a different audience on the second day, the evaluation came back extremely positive with unanimous agreement that confidence in delivery and benefits of delivering training were increased. The advice on how to deal with blocking behaviours was well received:

“Again, useful event. Some useful pointers for handling 'blockers' or 'spoilers'!”

“Good session on blocking behaviour and how to deal with it.”

As a result of PE training, the University of Derby stated that the main impact is increased involvement of engineering and technology staff and students at university open days, taster days and summer schools. The University of Derby also reported an increase in contact with schools and colleges, facilitated by extending the role and remit of the schools and colleges liaison tutor, building on current existing relationships and organising events in STEM. The training has also been utilised by postgraduate students from the Department of Chemical Engineering at the University of Birmingham, who have established an outreach scheme to deliver activities to local schools and colleges, and have managed to successfully deliver ten STEM activities related to chemical engineering since the PE training event.
Discussion

The main observation that arises from the project is the lack of engagement from some of the HEIs who had agreed to participate, and the unwillingness of some of those academics and postgraduate students who engaged with the project to provide answers to some of the open questions in the evaluation questionnaires. It is possible that the lack of engagement and the lack of response are due to the fact that many engineering academics would not consider outreach activities to be an important part of their workload commitments. Whereas in the past academics have considered their responsibilities to be restricted to teaching, learning and assessment, and the administration that this involves, currently academics are expected to perform extra academic-related activities. Given the increased workload undertaken by academic staff, it is feasible that academics lack the time to undertake outreach activities. The only way to encourage academic staff to engage in outreach may be to re-allocate workload to allow outreach activities to be incorporated into the workload of some academics, allowing others to carry the burden of existing activities.

However, there are also questions as to whether there are institutional cultures and attitudes towards outreach activities that either inhibit or enable outreach activities taking place, whether outreach activities are valued and whether outreach activities that prove to be successful are rewarded. Conversely the HEIs that did not participate with the project may already have established outreach activities programmes that are provided for schools and colleges and may have possibly questioned whether participation with the project would have provided any further benefits. If that is the case, the project provided an opportunity for these HEIs to disseminate good practice and methods of PE that have been successful to the other HEIs and towards the development of the virtual resource and the training session, and thus an opportunity to promote best practice has been overlooked.

For the first questionnaire, used to establish a baseline evaluation, there were seventy respondents in total. However closer scrutiny of the breakdown of results showed that there were not seventy responses for each question. All seventy respondents answered the question as to whether they were undertaking outreach activity with schools and colleges at the time of the questionnaire, of which twenty-seven responded that they were undertaking outreach activities. For the question as to where the outreach was being delivered, only twenty-one respondents provided an answer to that question. Assuming those twenty-one responses were provided by those who were undertaking outreach activities, it suggests that 78% of those undertaking outreach were prepared to state where the activities were taking place.

Respondents showed a reluctance to provide responses to some of the open questions. The 60% who indicated that they were aware of Health and safety requirements represented only twelve responses out of twenty. The 32% who stated an awareness of their HEI's target group for outreach represented eight out of twenty-five respondents. If the eight responses correctly represent awareness of target groups, this indicates that the HEIs are not communicating target groups to academics, which hinders HEIs that have widening participation policies. Also, the 4% of respondents who knew how to begin doing outreach work equated to just one response out of twenty-three. Forty-seven respondents to the questionnaire did not answer this question. Reasons need to be ascertained as to why so many respondents felt unable to provide an answer.

The PE training events that were delivered by Thinktank were well received by the target audience. As well as introducing the training package, a significant amount of time was spent focussing on areas that the initial baseline questionnaire had highlighted as being critical areas for consideration. In particular, the areas covered were evaluation and the STEM Ambassador programme. An additional area was that of developing activities, since Thinktank were aware that this is one area that if done correctly, can make the most significant contribution to a PE activity and it also leads very well into evaluation.

The Train the Trainer training event was developed to look at the specific audiences that the participants would be likely to be working with and methods of identifying their needs. Applying these principles, the PE training event was revisited to see how objectives are applied to the development of a training session. The latter part of the session then started to explore some of the elements that facilitation training might cover i.e. headline points to consider.
Summary
The project was partially successful in achieving its aims. Overall the project was successful in developing a virtual online resource that can be used to enable academic staff to undertake outreach activities, and it was successful in piloting a training event to introduce the package and to train academics to deliver the training at their respective HEIs. However there is no firm evidence at this stage as to whether there has been any embedding of the use of the virtual resource in participating HEIs, and it is yet to be ascertained whether the virtual resource and PE training have encouraged academics to undertake outreach at schools and colleges. It is hoped that academics will be able to dispel prevailing myths about engineering that limit recruitment to engineering degrees when undertaking outreach. It is also hoped that academics use outreach to target primary schools and secondary schools as well as sixth form students and college students, as delivering outreach to younger students may have a greater impact at an earlier age than with sixth form students who may have already chosen their prospective degree programmes.

Further development
It is intended to disseminate the results from this project through the National HE STEM Programme Conference at the University of Birmingham in September 2012. The baseline evaluation findings were presented at a STEM Conference at the University of Wolverhampton during June 2011. Intermediate findings were also disseminated at a HE STEM Programme seminar at Coventry University in September 2011.

Regarding sustainability, academics who attended the Train The Trainer event should be able to introduce the package and deliver the PE training to colleagues at their respective HEIs. It is expected that they will adopt the learning from running the training and run it as part of their ongoing outreach program each year, therefore embedding the practice which in turn sustains the activity within each HEI. It is also hoped that each HEI engages with the National STEM Ambassadors programme. STEMNET should be able to provide a list of academic staff from participating HEIs who have enlisted as STEM Ambassadors since the training events. It is also envisaged that the PE training is incorporated by STEMNET into the STEM Ambassador training, and for STEMNET and/or the STEM contract holders to deliver the training at the HEIs. The advantage of this is that STEMNET will benefit from increased exposure in HEIs, with the potential for more academics to sign up as STEM Ambassadors.

References


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