Abstract

The purpose of the project was to implement an inclusive and novel method of getting ‘hard to reach’ students across the Burnley and Pendle region to consider engineering as a career. This was achieved by organising a series of workshops for students utilising the recently developed Advanced Digital Manufacturing Technologies (ADMT) lab at the University of Central Lancashire (UCLan) Burnley campus, along with industrial visits for students to some leading engineering companies in the region. This interaction of students between the ‘real engineering world’ (in industries) and the ‘virtual digital engineering world’ (in the digital manufacturing lab) was designed to provide information and advocacy in a manner which would be appealing to students/groups and would raise their aspirations. The project successfully reached out to more than 100 students from three National Challenge schools* in Burnley. It demonstrated the idea that a holistic approach involving students, teachers, parents, role models and prospective employers along with cutting edge technologies provides an ideal platform for making a lasting impression on students’ minds which may help them to consider higher education-level engineering as a career path.

Keywords: outreach, hard to reach, digital manufacturing, STEM, UCLan Burnley, engineering careers

Background

This project aligned with the University of Central Lancashire (UCLan)’s strategy for promoting engineering and engineering careers in society, particularly targeting that section of society in which a significant proportion of the population are designated lower socio-economic groups and ethnic minorities. By providing access to cutting edge technologies in the UCLan labs and support from leading local industries, the project aimed to boost the confidence and raise the level of aspiration of students who are otherwise not encouraged to consider engineering as a career option. The project also supported one of UCLan’s mission statements of ‘Working in partnership with business, the community and other educators’.

The focus on the Burnley region is backed by data obtained from ‘Economic development and enterprise datasets’ (Government Office for the North West, 2008), which places Burnley in a lowly 12th position amongst 14 Lancashire sub-regions for the percentage of the population achieving NVQ3+ and NVQ4+ qualifications. A report published by The Royal Academy of Engineering in 2007 suggested that “much more must be done to ensure that school students perceive engineering as an exciting and rewarding profession that is worth pursuing.” The local employers in engineering/manufacturing disciplines, including the companies involved in this project, have similar experiences of having to cope with a shortage of skilled engineering graduates in the Burnley and Pendle areas. Following discussion with the staff of three National Challenge schools, it was identified that students do not receive enough information or are not motivated enough to consider higher education (HE)-level engineering as a career option. Although they participate in external careers fairs and events, they are not exposed to the ‘real engineering world’ and it is felt that traditional classroom-based resources and external careers fairs are not enough to inspire them and raise their aspirations.
The introduction of the National Challenge programme results from a pledge in the Children’s Plan that by 2020 at least 90% of children will achieve the equivalent of five higher-level GCSEs by the age of 19. The National Challenge programme sets out how the Government intends to ensure that all secondary schools achieve at least a 30% A*-C pass rate at GCSE, including English and Maths, by 2011.

**Rationale**

Staff in various schools across the North West region have reported that many of their students fail to recognise the benefit of further study in HE, particularly so for the engineering disciplines. Due to the fact that a large proportion of students from the regional schools comes from lower socio-economic groups, and about 20% from BME groups, it is desired that greater impetus is given to supporting students who may be the ‘first in family’ to consider the HE option. Although Burnley employs a significant proportion of the population in the manufacturing and engineering industries, engineering is traditionally viewed by parents as a low-skilled employment opportunity rather than a HE option. Some of the students’ family members from the lower socio-economic groups are employed in the regional manufacturing sector, but primarily as part of a low-skilled workforce and not as engineers, designers etc. They fail to recognise that engineering can be a satisfying and rewarding profession. These preconceptions are passed on to the younger generation who, as a consequence, fail to consider engineering as a potential career destination.

**The approach**

This project aimed at increasing the number of young people from the Burnley area interested in studying engineering disciplines, particularly from the ‘hard to reach’ group traditionally does not consider HE engineering as a career option due to various socio-economic factors. A holistic approach, which demanded participation not only from the students but also from their teachers and parents, was therefore necessary to change the perception. The project was therefore approached in such a way that it could satisfy the following three major outcomes, as envisaged at the outset.

**Outcome 1.** Students from specific communities where access is difficult through traditional classroom-based resources, careers fairs etc. should have a unique opportunity to explore engineering in a fascinating way which is more likely to improve their perceptions and raise their aspirations.

By introducing a novel approach of interaction between real and virtual engineering worlds in the Advanced Digital Manufacturing Technologies (ADMT) lab at UCLan, the students gained an opportunity for ‘hands-on’ experience of cutting edge technologies such as laser scanning, RFID (Radio Frequency Identification) tracking and computer vision. Once the students had acquired confidence in their ability to function in that environment, they toured the ‘real engineering world’ via industrial visits arranged by our industrial partners. They could visualise and comprehend similar technologies on an industrial scale with leading aerospace industries (partners), primarily Rolls Royce and Aircelle Ltd.

UCLan targeted three National Challenge schools in the Burnley region (Unity College, Shuttleworth College and Sir John Thursby Community College), all of which have a large proportion of students from lower socio-economic groups and about 20% from BME groups.

Two types of activities were planned and implemented: one full-day workshop of activities based at UCLan’s Burnley Campus and another half-day workshop and industrial visit to Aircelle Ltd, a leading aerospace company in the North West.

**Activity 1.** On Wednesday 13th July, more than 50 students from neighbouring Unity College and Shuttleworth College visited UCLan’s Burnley Campus to take part in a STEM Day with workshops being presented by UCLan, Burnley College and Rolls Royce. In addition to the engineering workshop sessions, the students had the opportunity to explore other university facilities, including the library, sports hall, etc.
UCLan’s session, in particular, utilised the ADMT lab facility, a specialised laboratory-based physical manufacturing environment where multiple technologies are integrated in a form of reconfigurable mobile and modular manufacturing stations. The students also took part in a competition, the aim of which was to put a component in a cup by manoeuvring a robotic arm. They also designed a pathway for programming the movement of a robot.

The sessions delivered by Burnley College involved both mechanical and electrical engineering sessions using their in-house laboratories and testing facilities. The session delivered by Rolls Royce involved an explanation of cutting edge technologies currently used in aerospace industries and provided an opportunity for students to discuss issues with their potential employers.

A number of staff participated in the day:

- UCLAN – 7 (including support staff)
- Burnley College – 5
- Rolls Royce - 5
- Student Ambassadors – 5

Dr Martin Brown, Director of Burnley Campus, commented on the session: “Engineering is absolutely crucial to the Pennine Lancashire economy with twice the national average employed in this area. It is also a key objective for our campus in Burnley to help raise the aspirations of young people to progress into higher education. This project gives a fantastic opportunity for young people in Burnley to experience advanced manufacturing and encourage them to consider it as a career.”

Activity 2. In this industrial visit, UCLan teamed up with Aircelle Ltd to show Burnley schoolchildren how cutting edge technologies are used in aerospace industries in order to raise their aspirations and encourage them to consider engineering in further education and as a career choice. 50 students from Sir John Thursby Community College and Unity College in Burnley visited Aircelle to find out about the different aspects of engineering in a world-leading aerospace company. The STEM session was led by Ged Garry, Project Manager at Aircelle, who introduced the concept of project management to the students and explained the importance of it in an industrial scenario. He also presented a corporate film which included the building of an A380 aircraft in quick time,
followed by a detailed and informative tour of the factory where the students learned about various technologies of A380 aircraft building, including computer aided design, composite manufacturing and non-destructive testing. At the end, the students were also given the opportunity to demonstrate their own project management skills and ‘build’ their own A380.

The event not only provided a great opportunity for school students to perceive engineering as an exciting and rewarding profession but also proved to be a good exercise for Aircelle to inspire and enhance the skill of their potential future employees.

A number of staff participated in the day:

- UCLAN – 2
- Aircelle Ltd – 5 (directly in organising and delivering the workshop), plus other support staff on the shop floor during the factory tour.

![Figure 2. Workshop session and industrial tour at Aircelle Ltd, Burnley](image)

**Outcome 2.** Widening participation: the project aimed to involve the school teachers and (to some extent) family members of the students in some ‘hard to reach’ communities. In particular, the project wanted to raise the aspirations of students who may well be the ‘first in family’ to consider HE engineering as a career destination and answer their questions on issues relating to routes to a career in engineering.

The school teachers were involved from the very outset of the project. They contributed to all aspects in terms of planning, marketing, collecting feedback and discussion with UCLan staff and workshop contributors. This active participation during the entire project particularly enthused the school teachers and encouraged them to explore areas of development and new ways to guide their students towards fulfilling their career goals. Furthermore, the teachers were also involved in collecting feedback from and interacting with the students’ family members. By involving family members of the students, the project also tried to raise the awareness of the target groups that play an important role in determining the career choice of their children.

**Outcome 3.** Involvement of other HEIs/employers etc. A wide pool of HEIs and other organisations willing to support the event and share our experience is beneficial to the collaborative development of similar larger scale regional programmes in the future. Our industrial partners in the project and potential employers in the region are always keen to participate in the events and enhance their corporate and social responsibility. It is also a good exercise for inspiring and enhancing the skill of their potential future employees.

At the end of the workshops, the students and teachers were given an opportunity to discuss issues with Rolls Royce and Aircelle staff. Furthermore, the project involved participation from actual role models, employers and other HEIs in such a way that a positive view of ‘engineering your future’ was represented at all levels. It is expected that increasing numbers of students from lower socio-economic backgrounds within the region will opt for HE engineering, benefiting the employers and HEIs (in term of student intake) in the long term.
Evaluation

The project was primarily evaluated by obtaining feedback in various forms through a number of focus groups, as described below.

Participating students and teachers: questionnaires were given to all students and teachers attending the symposium to allow for immediate feedback about the workshop. Using this data, a set of best practice instructions for similar events/activities will be produced in the future. The usefulness of organising such a workshop for students from the target groups was estimated from the feedback.

Feedback from family members: A special set of questionnaires was prepared for the family members of the participating students in order to gain an understanding of their views, considering the fact that a large proportion of the students would represent families from low socio-economic groups. This would assess whether the students face any barriers against raising their aspirations for pursuing a career in HE engineering.

The assessment procedure, based on the feedback of different focus groups, gave a clear indication of the effectiveness as well as the shortcomings of the project. The majority of the students were very satisfied with the delivery of the sessions; however, when asked 'Do you think engineering is exciting, as a subject to study or as a career destination?' about 30% of the students responded negatively. Of the four sessions, around 45% of students liked the workshop which involved a robot arm in the digital manufacturing lab most. This was closely followed by the electrical/mechanical workshop session delivered by Burnley College (25%), designing a pathway for a robot (18%) and the Rolls Royce session on aerospace (12%). These data gave a clear indication that, compared to the other workshops, access to cutting edge technologies available at UCLan’s ADMT lab had most impact on students’ attitudes, thus proving the usefulness of such facilities. The feedback from the teachers was equally satisfactory for all sessions. Some of their comments include:

- “The event was definitely a success. Our students definitely enjoyed themselves and the Aircelle staff made a point of telling us how impressed they were with them” (science teacher at Unity College).
- “The advanced digital manufacturing lab is an eye opener both for us and for our students. We would love to come back here and see more of it” (teacher, Shuttleworth College).

In terms of feedback from the parents, only 15% responded to the questionnaire, despite being given a month in which to complete it. This was after repeated requests were sent to them by the school teachers. It clearly shows that a more sustained effort is needed in order to raise the morale of parents which can have a big influence on their children’s career aspirations. Some of the responses from the parents suggest that:

- The majority of the children would be the first in the family to consider HE
- Most parents think that university education is an expensive proposition and this may be a critical factor for pursuing HE
- Engineering is a good career worth pursuing.

Discussion, summary

The project clearly demonstrated the efficacy of using cutting edge technologies to create a lasting impression on the students’ minds. However, it has been realised that much more work is needed to inspire students from lower socio-economic backgrounds to pursue HE in engineering. In particular, more effort should be made to include the participation of parents and family members and raise their ambition which can then be successfully transferred to their children. Based on the data obtained from feedback forms from students, teachers and parents (as described earlier), a set of best practice instructions for similar events in the future should be produced. However, UCLan will continue to engage with the participating institutions and measure benefits in the long
term by any increase in the number of students opting to consider HE-level engineering. The project has demonstrated that a holistic approach involving HEIs, employers, teachers and family members would prove effective in raising the aspiration level of students from lower socio-economic backgrounds and enhancing their prospects of pursuing engineering in higher education.

Further development
The project also opened the door for future work. Some of the school teachers and students expressed an interest in undertaking summer projects in the ADMT lab and UCLan would be exploring the resources needed to support the summer projects. There is also a possibility, developed during mutual discussion, of conducting joint outreach and public engagement programmes between Aircelle and UCLan. Furthermore, based on the response we received from students, teachers and industrial partners, UCLan is planning to develop a dedicated outreach module with a structured programme utilising the facilities in the ADMT lab, subject to availability of funding and resources.

References

Further reading/bibliography
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