Industrial lectures for level 4 electrical and electronic engineering students

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Abstract

This project was involved with the introduction of industrial lectures into the existing syllabus of the electrical and electronic engineering degree course at Newcastle University. The aim of the project was to increase student appreciation of the interdisciplinary nature of engineering and to highlight the relevance of taught material within industry. By improving student awareness of industry practice, we aimed to improve the progression, performance and student experience of level 4 electrical and electronic engineering undergraduates. To achieve this, the School of Electrical and Electronic Engineering has successfully integrated a series of industrial lectures into level 4 of its undergraduate course. These lectures complement the existing course content and experience has shown that there are positive benefits to all of the stakeholders involved with the project; undergraduate students, the school, and our industrial partners (employers). The overall feedback from students has been very positive and the willingness of industry to participate far exceeded our initial expectations. As a result, we are now looking to expand the concept into every year of the degree course. This case study clearly describes the implementation phases of the project and the key learning outcomes experienced throughout the work.

Keywords: industrial lectures, industrial engagement, industrial awareness, student progression, future careers

Background and rationale

The School of Electrical and Electronic Engineering at Newcastle University wishes to improve the progression rate of its undergraduate degree programmes. Historically, there is a significant drop-out rate, with students failing to complete their course. Analysis has shown that the first year of a degree course (level 4) is crucial; a major hurdle which many students struggle to overcome. For many, the transition to independent study from conventional schooling is challenging, resulting in them becoming disconnected from the subject. Students often enter electrical engineering with aspirations influenced by their day-to-day experience of technology and the exciting developments which regularly appear in the media. Exciting innovations such as mobile phones, robots, space travel and electric cars all help to attract students onto the degree programmes. However, the early stage of an electrical and electronic engineering degree typically involves substantial amounts of theory and mathematics. Most academics and industrialists agree that this material is essential, since it provides the necessary core skills required to work in the field.

Despite past attempts to update and increase the number of laboratory sessions within the course, there remains a feeling amongst some students that there is too much theory and not enough practice and examples. Students are not always clear why taught topics are important (or indeed relevant) and there is a general lack of appreciation that theory is crucial to designing and working with trendy and exciting modern technology. As a result, a proportion of students can potentially become disengaged during level 4. This is often reflected in poor attendance of lectures and a lack of enthusiasm from which it is very difficult to recover. Ultimately, some students drop out of the
course after level 4. For this reason, this project set out to increase employer participation at an earlier stage of the school’s undergraduate programmes than had previously been practiced. This has been achieved through the delivery of industrial lectures directly linked to each level 4 module of the electrical and electronic engineering degree course. It was hoped that a successful outcome would be increased student engagement and higher progression rates than experienced in previous years.

**Implementation**

The strategy for successfully implementing this project was comprised of three key implementation milestones and a single evaluation milestone, as shown in Figure 1. The following describes the first three milestones in greater detail (the evaluation milestone is covered in the Evaluation section).

![Figure 1. Project strategy](image)

1) **Buy-in from industrial partners**

The first stage of the project involved contacting companies to investigate whether industrial engineers would be interested in participating in the project. This involved making several phone calls, sending emails and, in some cases, arranging face-to-face meetings at company sites to promote the aims and objectives of the project. As there is no formal lecturing fee associated with delivering the talks, this teaching initiative obviously relies on significant goodwill from the industrial partners. However, it is recognised that students are the next generation of engineering talent and we realised that, from a recruitment perspective, companies are always looking for good quality graduates. It was therefore important for us to sell the project in a way that highlighted the fact that all parties would benefit from involvement.

2) **Organisation of lectures and timetabling**

The second stage of the project involved arranging dates for the lectures. In order to integrate the lectures into the course, co-ordination was required between the industrial speaker, the Industrial Lectures Co-ordinator and the module leader. Where possible, the school maintained as flexible a timetable as possible, appreciating that it can be difficult for external guests to get time away from their business. This phase of the work also needed to consider the realistic possibility of an industrial lecture being cancelled at the last minute. Due to the work responsibilities of the industrial speakers, it was important to accept that company business had to take priority over attendance at the university. We therefore required a contingency plan. To handle this risk to the project, we implemented two recovery actions. Firstly, within the school there are several Research Associates working on industrially-funded research projects. We approached a number of these researchers and managed to gain support from a small group willing to fill in for the external speaker if required. Whilst not technically an industrial lecture, their research work, being industrially-funded, had real-life application and represented a good “plan B”. However, it is worth noting that careful consideration has to be given to any non-disclosure agreements which may exist between the university and the industrial partner involved in the research. Indeed, for some
research associates it was not possible for them to talk about their work at all. The second contingency plan was to simply revert the session to a conventional course lecture presented by the module leader. Time permitting, the industrial lecture would then be re-organised for an alternative date.

3) Lecture delivery

Important, a member of school academic staff (typically the module leader) was always present during the industrial lecture. At a very early stage, this was identified as being key to the success of the project. Most visiting lecturers were new to the school and unfamiliar with the lecturing facilities. As is now the case in many universities, each lecture room is typically equipped with various data projection facilities and computers that are integrated into the campus network. For this reason, the presence of an experienced user of the equipment was essential to help the visiting lecturer set up and ensure that the lecture started and finished on time; demand for lecture rooms is very high and good time-keeping is essential. Whilst not assessing the lecture per se, this was also an important and obvious method of ensuring quality and content and a “good fit” with the overall course material. Furthermore, it allowed staff to get a feel for the attention and interest of students. During the project, additional reasons became apparent for ensuring that a member of staff was present at the lecture. It is easy to forget that, whilst the industrial lecturers have a wealth of experience and technical knowledge, they are not necessarily used to talking to large groups of early-stage undergraduate students, and it quickly became obvious that many of the industrial lecturers were keen to get feedback from the member of academic staff. Typically, questions from industrial speakers tended to be: “Was I okay?”, “Did I pitch it at the right level?” and “Was that what you expected?” For this reason, we found a need to provide an appropriate level of verbal feedback to satisfy the industrialist and to confirm the success of each lecture. Finally, it was found that students often asked questions after the lecture had finished, sometimes as much as several days later. Having the module leader present at the industrial lecture gave students a point of contact for discussion once the visiting lecturer had left.

Evaluation

Feedback from students was one of the most important means of assessing the impact and success of the project. Student feedback after the lecture series was generally very positive; however, we had to be strategic in our methods of obtaining the necessary data. Specifically, we did not hand out feedback forms during the industrial lecture itself as we did not wish to give the impression that we were assessing the performance of the industrial lecturer. Ultimately, the guest speakers are helping the school and we wanted an open and welcoming environment where they did not feel under any sort of pressure. For this reason, a short and simple questionnaire was sent to students towards the end of the project. This set out to measure the impact of the project as a whole, rather than assessment of each individual lecture. The questionnaire itself contained a concise set of eight questions felt to be the most important to the school in evaluating the project. Whilst further feedback from students is always desirable, long and complex forms have historically resulted in low response rates from which few meaningful conclusions can be drawn. The university is involved in many initiatives and projects which seek to gain information and feedback from students and they have often complained in the past about “questionnaire fatigue” as they are constantly being requested to fill out feedback forms. The results from the survey are summarised in the following charts. Out of a maximum class size of 63 students, the data presented is based upon returns from 46 students. This is a 73% response rate to the survey and is deemed to be a sufficient sample size from which to draw meaningful conclusions.
Overall, did you enjoy the industrial lectures series?

Do you think the industrial lectures series are worthwhile?

Overall, is the material in the industrial lectures series pitched at the correct technical level?

Have the industrial lectures given you a better insight into real-life engineering applications?
Generally, the results show a positive attitude towards the industrial lectures. Only a small number of students (three) expressed the view that they did not enjoy the lectures or find them worthwhile at all. Most students found the lectures to be pitched at a comfortable level at which they could understand the material being presented. That said, a proportion of students (seventeen) claimed that the material was either slightly or too difficult. Whilst we do not want the lectures to be pitched
at too high a level, this does show students why they need to focus on their studies and gives them scope for future improvement. A significant number of students found that the industrial lectures gave them a good insight into real life application of engineering and possible future career opportunities. This was a particularly pleasing result as it represented one of the main aims of the project, although the results perhaps show that there is a little more work to be done on highlighting future career opportunities. Encouragingly, the students gave a very positive response to the idea of expanding the lectures series into future years of the degree programme. This is a key indicator of the future sustainability of the initiative beyond the end of the project. Finally, and most importantly, the majority of students indicated that they were happy to have chosen electrical and electronic engineering as a subject area. This was a good outcome and highlighted that most students have the will to continue and succeed within our discipline. That said, the results indicate that there is further work to be done to target those students who still feel unsure about whether electrical engineering is the right field for them. This will be discussed further after the final examination results have been obtained in July and progression statistics become available.

In addition to the questions, students were invited to add further comments regarding the lectures. Whilst only a third of the forms included any additional comments (typical of most feedback forms), they did provide a lot of insight into the impact of the lectures and how we might set about improving them in the future from a student perspective. Notably, we did not receive any negative comments suggesting that the industrial lectures were undesirable. The following provides an overview of the comments received:

- ‘I found the industrial lectures were quite useful. They helped us to get to know about some of the local companies in the industry’
- ‘I felt that the lectures were short and the speakers didn’t get the opportunity to go into much detail about some of the things discussed to help us to understand material on the course’
- ‘The lectures did help to get an idea of where some of the material we study will be relevant and useful in a working environment’
- ‘They have given a brief insight into some of the projects going on in the north east and their research into renewable energy’
- ‘I would like to have heard from more companies to help build a picture of what is available to help decide the path my future career is going to take’
- ‘I found the industrial visits quite useful, where we had the opportunity to see [how] some of the theories and material we learn on the course is used in their research and development’.

**Discussion, learning and impact**

The intended goals of the work, in terms of delivery, have been achieved. We have successfully managed to integrate eight industrial lectures into level 4 of the electrical and electronic engineering degree. In most cases, we believe these lectures have successfully shown the application of the material we teach in an industrial setting. In a small number of cases, it was slightly more difficult to find a good fit at a level well suited to a level 4 student (for example, circuit theory). We view this as an on-going process and will seek to continually improve the linkage between the industrial lectures and the module content.

Importantly, the overall feedback from the students has been positive and they have generally been supportive of the industrial lectures initiative. They seem to appreciate that this is an important element of their degree course and that it gives an insight into the issues which engineers face in practice, such as methods of design, project management and intellectual property. Interestingly, some students wished to learn more about the material presented in the industrial lectures and some expressed the opinion that the one-hour session was insufficient. However, due to the complicated timetable within the university, lengthening this time would be very difficult. Furthermore, a two-hour lecture is possibly too much to expect from a visiting
lecturer. For this reason, some additional work and discussion is required within the school to best identify methods of supporting the students in their desire to further their knowledge. Options may include a follow-up lecture or tutorial session delivered by the module leader with more in-depth discussions on the subject described by the industrial speaker.

One of the major lessons learnt from the project is the willingness of industry to engage with students and support universities. From discussions with the guest speakers, it is clear that industry is keen to recruit high quality graduate engineers and is prepared to work with universities to gain access to potential future candidates. Some companies have expressed an interest in further engagement with the university in terms of offering student sponsorships, summer placements and input with curriculum review. This will all help to ensure that our courses are industrially relevant and that our students are more prepared for work once they graduate. This has been a welcome outcome from the project and has contributed towards the setting-up of an industrial advisory board within the school to strengthen all industrial engagement activities. Finally, lessons have also been learnt with respect to the organisation of the lectures and the need to provide more feedback than originally expected to the industrial speakers immediately after delivery of the lecture.

Further development and sustainability

This project has shown clear benefits to all partners involved. Improved graduate skills, industrial awareness and employability bring long-term sustainable benefits to the engineering community and to the university. Provided the school adopts a proactive approach to developing the industrial engagement theme, the industrial lectures series can continue to run successfully in future years. Our aim at the beginning of this project was to improve the degree course by establishing stronger links between the school and a core group of industrial partners. This mechanism is now in place and there is goodwill on behalf of all partners. As a result of the work on this project, we are now looking to expand the industrial lectures into every year of the undergraduate course and potentially develop a series of industrial visits to local companies.

Outputs

At the time of writing this case study it is too early to publish the full outcomes of the work. Full results will not be available until the end of the current academic year when we will be able to evaluate the academic performance of the students in the year-end examinations and thus review progression statistics. Outcomes will be shared amongst other schools at Newcastle University through our teaching initiatives group and internal conferences. We will provide support to other schools interested in embedding similar practices into their programmes, thus minimising duplication of effort. External dissemination opportunities will also be sought in due course.