

Developing employability within a university engineering curriculum

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This article provides case studies for incorporating employability in a higher education setting. A professional studies module for a small class (30 students) of third-year aerospace engineers gave insight into industrial challenges while promoting career development. It was delivered mainly by industrial speakers and involved practical tasks and workshops. A more sustainable employability curriculum now supports students in all four years of the School's three degree programmes, offering a structured development of skills and sector understanding. A notable increase in students obtaining sandwich year placements has been observed.

Introduction

In the UK, the Engineering Council is the regulatory body for the engineering profession (www.engc.org.uk). It sets standards of professional competence and licenses engineering institutions, such as the Royal Aeronautical Society or Institution of Mechanical Engineers, to accredit degrees to the Engineering Council standards, the UK-SPEC (www.engc.org.uk/professional-registration/standards/uk-spec). Competence is required in various areas including applying theoretical and practical methods to the analysis and solution of engineering problems, providing technical and commercial leadership, and demonstrating effective interpersonal skills. Accredited engineering degrees have learning outcomes related to the UK-SPEC standards of competence. General learning outcomes such as group working, appreciation of economic and commercial considerations, problem solving and understanding of underpinning science and maths are clearly relevant to the graduate attributes desired by employers (Shearman and Seddon, 2011). Thus, the

UK-SPEC provides a framework to help universities prepare students for employment in terms of both technical knowledge and skills.

Cranmer (2006) presents six different methods of incorporating employability skills in the higher education curriculum. These range from total embedding of skills (the skills are present and in context but students might not be aware that they are developing them) to parallel development (separate from the main academic curriculum and with limited contextualisation) with some variations in between. An embedded approach was believed to be more effective.

The importance of students being aware of the purpose of each learning activity in developing skills was also highlighted in a report on pedagogy for employability (Pegg et al, 2012). This would enable students to describe their personal development more clearly. Integrating employability into the core academic curriculum was recommended, with assessment through realistic tasks relevant to the discipline, and active or experiential learning would successfully promote exploration, reflection and engagement. The report states that while genuine work experience is a strong factor in contextualising learning, enhancing employability through work experience is strengthened by reflection, evaluation and expression of the learning achieved.

The UK Commission for Employment and Skills (UKCES) (2008) reported a lack of convincing evidence for some pedagogical approaches deemed effective. However, themes for best practice included work-based, active learning with an authentic context (problem solving or project), reflection on learning experience, collaboration with peers or other stakeholders, and employer involvement in the design and delivery of the curriculum.

Harvey and Bowers-Brown (2004) are concerned that, in developing employability, too much attention will be given to developing work skills in the sense of training for employment. They argue that the focus should be on nurturing critical, reflective practitioners who are capable of ongoing development during their careers. A similar theme is outlined by Cox and King (2006) who interviewed employers to ascertain what skills they considered necessary for student employability. In addition to recommending certain skills, the employers desired a depth of understanding and this idea was represented by three layers – theory, tools and application. The paper states that, from an employer's perspective, employability means that 'a person possesses the capability to acquire the skills to do the required work, not necessarily that they can do the work immediately and without further training' (Cox and King, 2006: 263).

The current article reviews the integration of employability skills within the undergraduate engineering curriculum in our School. It begins by describing a professional studies module which was developed over 10 years for aerospace engineering students, before being discontinued due to the need to teach an increasing number of students more efficiently. The article then describes the revamped employability programme which was designed for all second-year students across the School's three degree programmes – mechanical, aerospace and product design engineering. Thus, the article provides case studies for incorporating employability and career development in a higher education setting.

Aerospace Professional Studies

This module, worth 10 CATS points, was compulsory for third-year aerospace engineering students; about half were in their final year (BEng programme) and half were in their penultimate year (MEng programme). It occurred at an appropriate time for job applications – typically, there was a two-hour lecture slot each week for 10 weeks during the autumn semester. The module provided a balance between professional engineering (examples of current industrial challenges) and professional development (skills, career preparation). Significantly, it was delivered mainly by industrial

speakers who brought various interesting perspectives. Active learning was encouraged and constructive interaction occurred between students and speakers.

The module had developed since 2002/03 following much consultation with and encouragement from the university careers adviser responsible for engineering. The objectives of better informing the students regarding the aerospace sector and developing effective presentation, commercial awareness and career management skills were very relevant. In a CBI survey (2008), 86 per cent of CEOs ranked employability skills as the most important consideration when recruiting graduates. Furthermore, in June 2010, the universities minister highlighted 'employability statements', requiring universities to consider what they 'offer students to help them become job-ready in the widest sense' (Willetts, 2010).

In order to fulfil the objectives in a stimulating, up-to-date way, the material was presented mainly by people working at the forefront of engineering, with exciting stories and videos. The range of speakers illustrated the range of career opportunities. Various perspectives, from director to recent graduate, were included. Various organisations, from international to small enterprise, participated. A non-aerospace company representative demonstrated transferability of skills. Having graduates of our university, and some relatively young speakers, encouraged empathy between speakers and students.

Particular aspects of the module in its final year of operation (2011/12) are now summarised. A director from Thales, a defence company, discussed recent projects and showed that an engineer's technical skills are not sufficient when working in industry. Awareness of commercial and strategic challenges is also vital. A visit to B/E Aerospace, the world's leading manufacturer of aircraft seats, gave students a unique insight into industrial practice and a connection to other topics from their degree including manufacturing, composite materials and lean engineering. The factory tour was followed by an assessment centre exercise where the students tackled a realistic problem in teams before presenting their solution to B/E engineers. A British Airways captain gave a fascinating overview of his job, described how engineers contribute to commercial aviation and advised those

interested in pilot training. Through listening to cockpit and air traffic control recordings, and discussing recent air accidents, important aspects of teamwork were highlighted. Two visitors from Airbus, another global leader, gave a workshop on teamwork. Some students worked in groups on a given realistic problem and others observed, aiming to identify characteristics of a successful team, so important in industry. Two employees of Accenture gave a class on interview skills in which student participation – interviewing each other – was prominent. The company representatives were aerospace graduates of our university in 2010 and therefore very familiar with the students' circumstances. At Accenture, they noticed that graduates from Northern Ireland seemed less confident. This underlines the need to show students that they possess many relevant skills which enhance their employability.

Each year's programme was slightly different. Previous speakers included a self-employed builder of flight simulators and an aerospace engineering graduate working for Unilever, a company not associated with aerospace. This talk was useful for those who do not necessarily want to work in the aerospace field. The students were shown that they have many skills which are valued and applicable in other areas of engineering. The involvement of employers in the delivery of the module and the active learning aspects are examples of good practice (UKCES, 2008; Pegg et al, 2012).

Assessment

Assessment was entirely by coursework which was designed to be relevant. Students had to write an executive summary based on the commercial awareness lecture to test their understanding of how engineers were successfully involved in developing a local, high-tech engineering business. Following the pilot's lecture, they had to plan and report on an imaginary aid flight mission to Africa; this involved aircraft load calculations and consideration of aircraft performance at different altitudes and temperatures. They also had to prepare a CV and give two group presentations. Students received written, individual feedback on their summary and a corrected/improved CV was returned. For their first presentation, students assessed their peers formatively. This required them

to observe actively and identify good/bad presentation techniques. The assessment, as well as the presentation, was performed in groups. The comments were quickly returned to the presenters allowing them to focus on improving before their second presentation. The presentation topics had an aerospace theme. For example, for their second presentation, students chose an aerospace company and reported on its structure, products and recruitment procedures. Therefore they became familiar with many potential employers while enhancing presentation skills.

The use of practical tasks for the assessment and during the sessions (for example, the problem solving exercise during the factory visit), plus the collaborative nature of the tasks, have been highlighted as effective practice (UKCES, 2008; Pegg et al, 2012). Overall, the module fits the category described as 'bolt-on generic skills' (Cranmer, 2006: 172) in which skills are visible, in context and assessed explicitly and which is believed to have a high impact on the curriculum.

Impact and feedback

Good attendance at the classes was normal, averaging 85 per cent over 10 years. Student feedback indicated they appreciated the relevance of the module, enjoyed the speakers and gained confidence. This is illustrated by the following student comments.

- 'Motivates me to do well.'
- The pilot's 'lectures were inspiring'.
- 'Was positive to see employees from such highly regarded companies taking time out to visit.'
- 'The assignments had a real life application and purpose and this made more enjoyable to complete.'
- 'Helps the student understand how useful his degree is.'

Quantifying the impact of the module on the students' learning is difficult but it was observed that, during this period, sandwich year work placements for the aerospace students were much more common after third rather than second year. The module was possibly an important motivating factor here. Note that the

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sandwich version of an undergraduate degree includes a year of relevant work experience at some point after second year and before final year.

The ongoing support of enthusiastic speakers was significant. Most participated eagerly year after year. The British Airways captain noted the students' 'tremendous enthusiasm' which 'was reflected in their attitude towards myself and in the way they received the lectures'. An engineer from B/E Aerospace was keen to 'leave a lasting impression' to encourage future applications to his company.

The module featured in a report (Foskett and Johnston, 2006) on credit-bearing careers education and could easily be adapted by others. However, a review of education provision within our School, while being mindful of the need to teach an increasing number of students efficiently, led to a common suite of professional studies modules provided across the three degree programmes (mechanical, aerospace and product design engineering) and the discontinuing of Aerospace Professional Studies. The main focus for employability within the curriculum was now aimed at second-year students and the next section of this article describes the revamped employability programme.

Employability Programme

In April 2012, and with the need for a systemic and sustainable intervention of the employability curriculum, a School-based placement officer was appointed to manage and monitor placement learning and to deliver the employability programme. Clearly the aerospace programme was of significant value to the approximately 30 students on the course each year. The challenge of the School-wide programme was to provide a comparable experience but with over 200 students in each class. This has been achieved in the main and feedback, both immediate (module evaluation) and longer term (student placement portfolio acknowledgments), has been positive from students, staff, industry and the professional bodies' accreditation panel.

The employability programme in 2012/13 comprised 12 two-hour sessions on Wednesday afternoons which

were filmed for students to review subsequently. As Wednesday afternoons are traditionally free for clubs, societies and sports, the scheduling of the programme might have given students the impression it was not a high priority for the School. Session topics included:

- **Skills in the workplace** – information about the key skills employers seek in an engineering graduate as informed by the CIHE employability skills profiles (Archer and Davison, 2008).
- **Making applications and CVs** – students were provided with key principles for building a good CV and then asked to review each other's and give feedback.
- **Assessment centres** – interactive session delivered by key engineering recruiter, Jaguar Land Rover.
- **Team work** – consideration of team roles and completion of a self-perception questionnaire.
- **Interview skills** – session delivered by Accenture focusing on the principles of effective interview techniques.
- **Career options** – provided students with a sector overview informed by our graduates' destinations and graduate labour market intelligence.
- **Going global** – information session underpinned by the 'Global Graduates into Global Leaders' publication (Diamond et al, 2011).
- **Optimising your learning experience through reflection** – this focused on the practice of reflection (Little, 1998; Pegg et al, 2012).

The module is not credit-bearing but appears on the students' transcripts as 'pass' or 'fail' based on attendance – a pass requires attending a minimum of nine of the 12 sessions.

All students have the option to undertake a placement year during their degree. Much effort is directed towards encouraging this given the belief that many desirable employability skills 'can only be learned in 'real life' employment situations, even on a temporary basis such as work placements' (Johnson and Burden, 2003: 39). Since the placement officer

was delivering the employability programme, it was deemed appropriate that it became the vehicle for placement preparation initially. However it was clear that preparing students to understand the importance of placements at the very time the placement vacancies were being advertised was leaving it too late. From these initial reflections a wider employability programme was conceived.

The expanded programme

In the current year (2014/15), a range of career development opportunities has been provided across all stages of the degree programmes with significant industrial input and support from the university's careers service. This aims to promote a progressive growth of self-awareness, knowledge, skills and understanding of the graduate labour market and give students an ideal platform for their career development.

First-year students were provided with a series of sessions in the first semester that required them to articulate their motivation for studying engineering, understand the skills engineering employers seek, conduct a skills audit and become more aware of summer work experience opportunities and the importance of starting to develop an employability profile. The onus at this stage is to ensure students have the opportunity to understand their options and gain summer work experience as a platform for skill development. The Sentinus programme, PwC and the Royal Naval Reserves all offer such opportunities so were included as session contributors. To prompt students to evaluate their current level of skills and attributes, they were asked to submit a 300-word statement as if applying for a summer vacancy. This formed the basis of each student's personal development planning interview with their personal tutor.

The second-year students were all enrolled on the employability module (as described previously) which still focuses on preparing for the sandwich year placement. The module is now timetabled within teaching time on a Monday afternoon as a result

of pressure from the students and the pass rate this year (based on attendance) was 96 per cent (average weekly attendance of 180 students), a large improvement on the 2012/13 pass rate of 75 per cent. With the introduction of the first-year sessions, a lot of the ground work including understanding employers' skill criteria, understanding personal skill development and building a CV are in place. Therefore, module content has been adjusted and augmented by sessions on digital citizenship, international options, psychometric testing (interactive tests were provided in the session), assessment centres and situational judgement testing. An additional session was converted into a speed networking event in which 12 local employers interacted with students to their mutual benefit. Employer comments included support for the freshness of the format, 'something a little different to get students engaged'. Also, students could book to attend a tutorial-style seminar focusing on interview skill techniques co-hosted by the School's placement officer and a different company each week. The inception of this activity and the speed networking event were driven by feedback from employers who felt our students were strong on paper but lacked interview and interpersonal skills.

Since the placement year is optional, there is an emphasis on engagement, understanding and encouragement to assist students to take this option. Given that students are influenced by each other and, with placement being such an individual activity, finding a mechanism for them to feel as a group is important. The educational software, TurningPoint, has been applied successfully; it provides students with an anonymous means of voting as a group to contribute to a group understanding (Blasco-Arcas et al, 2013; Donohue, 2014). For example, the software was used to collate students' views on the main benefits of undertaking a placement, thus providing them with a variety of opinions and aiding the marketing of the placement option. The numbers of students undertaking the placement year has increased as follows: 54 in 2011/12, 71 in 2012/13, 80 in 2013/14 and 106 in 2014/15. This growth is believed to be mainly due to the second-year employability module. The full impact of these numbers on the proportion of sandwich degrees is not yet realised but Figure 1 shows the strong upward trend.

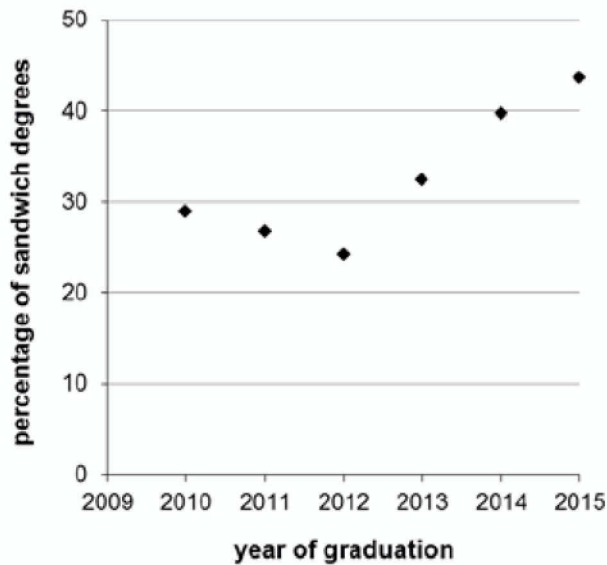


Figure 1.
Proportion of mechanical, aerospace and product design engineering graduates on the sandwich degree programme.

Several of the sessions within the first and second-year programmes – most notably, the skills audit – require students to learn actively about themselves through reflection. This approach is continued when students are on placement as a means of benchmarking their skills before, during and after placement. The process of reflection in an experiential learning context is highlighted and broken down into the key areas of learning: act, reflect, conceptualise and apply (Kolb, 1984). The second-year session involves students at the ‘act’ and ‘reflect’ points of the cycle. When on placement, students are required to complete the cycle for key skill areas including managing tasks, communicating effectively, working with and relating to others, and applying initiative to solve problems. Through keeping monthly diaries and compiling a portfolio, students have a structure to aid this process, as endorsed by Little (1998). The diaries help to document the ‘act’ and ‘reflect’ points. Students then must ‘conceptualise’ by determining the skills they have developed in undertaking the tasks. Articulating their objectives for improving their knowledge and skills constitutes the ‘apply’ phase of the cycle. Thus, students on placement are expected to be critically and continuously evaluating their skills and experience. Submission of a satisfactory portfolio at the end of the placement year is necessary to fulfil the academic

requirements of the sandwich year. The portfolio is assessed on a pass/fail basis and counts for 120 CATS points.

In third and fourth year, graduating students are offered 10 one-hour (optional) sessions focused on the graduate labour market and delivered partly by industrial speakers. Session topics include professional registration, postgraduate study options, lean manufacturing techniques, project management and leadership. Development of the employability programme is ongoing with the inclusion of entrepreneurial activities being considered while peer mentoring could be adopted by third and fourth-year students supporting first and second-year students with placement applications.

Conclusions

The Aerospace Professional Studies module involved career learning, employability and skills integrated into an effective learning experience for third-year aerospace engineering undergraduates. Industrial speakers participated keenly and practical tasks were used for the assessment and during workshops. Students enjoyed the module and appreciated its relevance.

With a sustainable approach to the employability curriculum needed, a School-wide programme has been developed. It is subject-specific, focused on relevant sector areas (engineering) through significant engagement with employers of various sizes. It provides support for students in all four years of the degree programmes, thereby offering a step-by-step, progressive build-up of knowledge, self-awareness, skills development and sector understanding to ensure they are ready for the graduate labour market. It uses central university services alongside industrial expertise to help deliver the topics. Within the School, it would be impossible to provide the range and number of sessions currently offered. This has had the added benefit of highlighting central services to students; indeed, during the first semester of 2014/15, the proportion of students from the School of Mechanical and Aerospace Engineering booking a career guidance appointment was at least twice that for any other school in the university. One clear

positive impact of the programme is the increased number of students doing a placement year.

Of course, the programmes described here do not represent the only opportunities for students to develop employability skills – there are many examples of practical, analytical, computational, presentation, team-working and research skills embedded over the curriculum within academic modules.

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