Integrated work-based learning in clinical engineering education

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Abstract

Traditionally, engineering higher education has not made use of formal work-based learning (WBL) (Aslin et al., 1995). Where WBL has occurred it has been in the context of a sandwich placement year and there has been limited integration with the taught part of the course. This project aimed to develop credit-bearing WBL for a series of placements integrated into each stage of a clinical engineering degree course. The programme is vocational, focused on healthcare science careers within the National Health Service (NHS) and requires close partnerships with hospitals. From this project we hoped to establish an integrated WBL model that could be applied to the wider engineering sector.

Keywords: Work-based learning, innovative curriculum development, employer engagement

Background

The School of Engineering, Design and Technology (SoEDT) was the first in the UK to offer a Medical Engineering BEng and has been developing programmes for engineering and scientific hospital staff since 2001. In 2004 we launched the first full-time Clinical Technology BSc.

The Department of Health 'Modernising Scientific Careers' (MSC) initiative has made the integration of WBL in such programmes mandatory (Department of Health, 2010). While SoEDT has a long history of industrial placements, and more recently WBL, we have not delivered programmes with mentor-led credit-bearing training before.

The University of Bradford was one of the few HEIs to secure additional student numbers for these new healthcare science programmes and we are the only HEI to deliver the new format clinical engineering course in the current academic year. This means that we are part of a small group of HEIs developing healthcare science WBL and the only one developing clinical engineering WBL.

Although integrated credit-bearing WBL is unusual in engineering, use can be made of the experience elsewhere. This model of learning is very common in the health sector, where the combination of knowledge and understanding, subject-specific skills and professional skills are often seen as essential to an undergraduate degree. While the same could be said of engineering, the approach to education and training tends to be very different. There is also considerable experience in the further education sector and part-time providers such as the Open University (Harvey and Norman, 2006).

The Department of Health intends that successful completion of an approved healthcare science degree with integrated credit-bearing placements will be a requirement for all NHS employees in science and engineering practitioner roles and that this will form the basis of future regulation. This project could therefore shape education and training across the profession.

Rationale

The project aimed to develop credit-bearing WBL as an integral part of full-time healthcare science (clinical engineering) BSc programmes and to use this as a model for the wider use of WBL in engineering.

The objectives of the project were to:

- in collaboration with employers, develop training materials and assessment tools that meet academic and employer requirements
- develop administrative systems for the management and support of student training placements, including mentor training
- develop training programmes for workplace mentors
- apply the principles and systems developed to other engineering programmes across SoEDT
- share experience of developing these new vocational courses (clinical engineering WBL in particular) with the wider HEI sector.

On successful completion of this project, it was planned that the outcomes would:

- play a key part in developing new vocational engineering degrees for the health service. This is an issue of national importance and is not currently being dealt with elsewhere
- feed into the emerging MSC framework, establishing a system for clinical engineering work-based training placements for adoption across the healthcare sciences
- allow the engineering discipline to benefit from best practice in WBL from established training programmes in the life and physiological sciences
- build links with NHS employers and ensure graduates are 'fit for purpose' and highly employable in the health service.

The approach

Developing the employer network

While this project relied heavily on close working with NHS hospital trusts, the process for developing a network of collaborating employers was not well thought-out in advance. A lack of financial support to implement MSC for hospitals, students or universities meant that we could not offer any monetary incentive for employers to get involved. In the life sciences there was already a culture of training undergraduates, but this was not the case for engineering. While we could argue the benefits of taking on trainees in terms of their unpaid contribution, training for existing staff and the opportunity to assess and shape potential new employees, we were largely reliant on the goodwill of employers.

Developing the study materials

The curriculum for the WBL was closely controlled by the MSC group at the Department of Health and adherence to this was a requirement for accreditation. Clinical engineering splits into four pathways, with students specialising in medical engineering, rehabilitation engineering, renal technology or radiation engineering, necessitating a programme curriculum with a mix of shared and specialist elements. In addition, the diverse stakeholder input into the curriculum, at a national level, has led to a dense and proscriptive set of knowledge, understanding and skills requirements. Due to the developmental nature of these courses, the details of this curriculum were not available until well into the project (National Health Service, 2011). This lack of guidance led us to follow an approach closer to problem-based learning than we would otherwise have taken. Rather than providing students with large amounts of structured study material, they were supported through their own searching of the literature.

Developing the assessment tools

Assessment for the WBL component of these courses comes in two parts: credit-bearing assignments and competency-based assessment. For example, one competency is 'Demonstrate basic life support skills', which is assessed on a pass/fail basis and is part of a prescribed list of competencies that must be acquired during the course (National Health Service, 2011). In contrast, the phrasing of the assignments within the module descriptors allows scope for the tutor, mentor and student to tailor the submissions to the work conducted in placement. The emphasis upon reflection on personal and professional practice intensifies with increasing academic level. This was seen as important, as reflective practice is not something that generally comes easily to engineering students.

The competency-based assessment is managed through a national web-based system, developed with NHS West Midlands and recently put out to tender for full roll-out. Students can decide when they are ready to be assessed and submit an assessment request to an assessor of their choice. The assessment method might be direct observation of procedural skills (DOPS) or case-based discussion (CBD). The pass/fail status of the assessment and the feedback are then recorded on the system. This system has been adapted from one used in a formative context and we have worked with the providers to add functionality to allow tracking of summative assessment progress towards the programme requirements.

Training the mentors

The training of supervisors to perform a mentoring and assessment role was seen as a key part of developing these courses. Fortunately we were able to build on the existing training expertise in the School of Life Sciences (SoLS). However, the assessment processes for these courses were new to everyone and the whole process was new to the engineers. Supervisors were sent a number of training resources and invited to a two-day training session at the university. This session covered introductions to a number of general teaching issues, the degree courses, specific training issues and assessment. In addition, experienced mentors were invited to a half-day session on the assessment processes.

Briefing the students

The briefing sessions for the students followed a similar format to those for the mentors. However, many of the students' concerns were of a more practical nature, such as transport and accommodation. The relatively short duration of placement, repeated placements throughout the course, potentially different placement locations and lack of financial support make these concerns rather different to those of traditional sandwich placement students. It will take time for us to develop the experience and administrative structure required to fully support students in this aspect of their training.

Supporting students in the workplace

Students were visited by a university tutor twice during the initial ten-week training placement. In addition to this they were encouraged to make use of peer support, either through the university web-based systems or directly. Students also contacted university staff directly with specific queries but saw peer support as the most important way of sharing best practice.

Evaluating the process

Informal feedback was sought from supervisors and students throughout and this was used to help develop our processes. Formal feedback was also sought from both groups after their briefings and towards the end of the initial placements.

Assessment

The engineering students have yet to experience DOPS and CBD and will need guidance in these new forms of assessment. The student-led assessment process (with students deciding when they are ready to be assessed) was new to everyone. Once students became comfortable with this they made enthusiastic use of the system, collecting assessments on various aspects of their training as they went along.

Evaluation

Our existing local employer contacts were less fertile than we had imagined and this highlighted the need for regular dialogue with employers to maintain relationships. Approaches to individual trusts were very time consuming and had limited success. By far the most productive route to establishing a group of collaborating employers was through existing networks such as professional bodies (e.g. the Association of Renal Technologists) and regional bodies (e.g. Yorkshire and Humberside Strategic Health Authority).

The main factors that employers reported for their involvement in placement training were:

- a need for employees with the knowledge and skills to be 'fit for purpose'
- the opportunity to assess the capabilities of potential employees and to shape their skill set
- the opportunity to shape the MSC implementation process.

Interestingly, while some employers did see the benefits of trainees as a 'free' extra pair of hands (the students are unpaid), this was a minority view. Trainees were generally seen as resulting in a net increase in workload for departmental teams. This will almost certainly be the case for the initial placement, where students are largely work-shadowing. However, as they progress through the course and develop their skills and understanding, they will arguably start to make a significant positive contribution in the workplace. It will be interesting to follow this up in future years to see how the perception of the value of taking on trainees changes as employers gain experience of the process.

Although only a small number of students have been on placement so far, the feedback from both students and supervisors has been very positive. Trainees rated all aspects of their placement experience as 'very good' or 'excellent', while supervisors rated the students as 'good' or better in all aspects of their training. The online assessment tool was also rated as 'good' or 'very good' across all factors.

Discussion, summary

We had considerable concerns about adopting a problem-based learning approach to WBL due to our expectation that students would have difficulty accessing library facilities at the university while on placement. In fact, this was not generally seen as a problem by students. Larger hospitals have their own libraries, but students made most use of online resources and their Athens accounts (an access management system developed by Eduserv) allowed them to access material as if they were based at the university.

Despite a number of setbacks, this project has been invaluable in the establishment of credit-bearing WBL in clinical engineering. The integration of placement learning at every stage in an undergraduate programme has proved to require a bigger cultural change than we had foreseen; however, the benefits to the student learning experience and the range of skills acquired are immense. Placement integration has posed practical challenges, such as timetabling and placement management, as well as more philosophical ones surrounding the purpose of higher education. The inclusion of competency-based assessment has been particularly challenging to notions of what engineering higher education should be. It will be interesting to see how the engineering professional bodies react to this programme format when we approach them to accredit the courses.

There have also been great benefits from working closely with employers which reach wider than this taught course. Employer-informed teaching and teaching contributions from employees has enriched our teaching across a range of subjects and has led to high levels of student engagement. The extensive employer network created for this project has also led to new research opportunities, collaborative partnerships and access to facilities. However, the administrative burden of developing and running this type of provision should not be underestimated.

Further development

This project has established the foundation for integrated WBL within these courses, but there is still considerable work to be done. As the students progress through their courses the number and variety of training placements that the university administers will increase until, once the first cohort graduates, we reach a steady state. We will also have new challenges to face, such as the implementation of work-based final year projects. The university is committed to sustaining these courses in the long-term, although the future of the MSC initiative is still less than certain.

For engineering in general, the integration of WBL into undergraduate programmes will be rolled out to other courses in a gradual way. This approach is already being used for part-time and foundation degree students within SoEDT.

References

Aslin, P., Challis, M. and McEwan, P. (1995). 'The Role of Work-Based Learning in Engineering Degree Programmes', *Capability,* vol. 1, no. 3, pp. 31-38.

Department of Health (2010) *An Overview of Modernising Scientific Careers,* London, Department of Health.

Harvey, M. and Norman, L. (2006) *Work-based Learning: Models and Approaches*, Milton Keynes, Centre for Outcomes-Based Education.

National Health Service (2011) *Healthcare Science Practitioner Training Programme Training Manual 2010/11: Modernising Scientific Careers,* London, National Health Service.

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