

EMBEDDED EMPLOYABILITY

A guide to enhancing the university curriculum



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PREFACE

Universities are becoming increasingly aware of the importance of ensuring that their graduates have an appropriate range of skills for employment. The 'employability' of graduates has been emphasized by a whole range of interested parties. Universities – and, in particular, Science, Technology, Engineering and Mathematics (STEM) Departments – should respond positively and imaginatively to the requirements and more demanding expectations of students.

STEM graduates are employed in a wide range of careers, and their academic training means that they have a great deal to contribute. However, it is important that departments assist their students to acquire those skills that will be valued by employers: they will have to devote careful attention to the skills and aptitudes that will make their graduates competitive when seeking initial employment and which will be a foundation to adapt to changing circumstances. Flexibility and adaptability will be paramount. Graduates will generally work as part of a team, and their team working and communication skills, for example, will play a significant role in their career success.

This guide is designed to provide departments and their staff with some ideas about the range of appropriate employability skills and how they can be integrated into the academic curriculum. The acquisition of these skills cannot be an optional extra – it is essential that students are helped to acquire them in a way that is carefully linked to development in their academic discipline. As well as providing a framework, the guide includes a number of case histories of successful initiatives. Detailed implementation will depend very much on the particular emphases of a course.

In addition to the skills they can offer as a result of their academic training, STEM graduates must also display those other characteristics valued by employers. It is the responsibility of departments to provide their students with the best possible background for obtaining satisfying employment and contributing with maximum effect to the work of the organisations and companies for which they will work.

I am delighted to commend this guide in the hope that it will be of some assistance in the increasingly important task of associating general employability skills with the academic curriculum, and so help to satisfy the requirements of students, employers and government.



Professor Noel Lloyd CBE
Aberystwyth University



OVERVIEW

This guide aims to provide support to universities, in the development of an employability agenda to close the gap between the skills needed for future business growth and the skills being acquired by current graduates. Employability is an increasing part of the responsibility that HEIs have to their students and is also one facet of a more general drive on the part of government and HEIs themselves to focus attention on the ways in which they contribute to economic growth.

Through the creation of high-calibre graduates, universities contribute importantly to the future development of all sectors of the economy. At the same time, employers consistently comment on the gap between the current capabilities of graduates and the skills they require. The authors hope this guide contributes a fresh perspective to the discussion and will provide HEIs with concrete ideas for creating strategies that develop employability skills within the curriculum. Its primary audience comprises senior managers in HEIs, from Vice-Chancellors to Heads of Department, together with companies and other external partners who wish to help HEIs create the workforce that will be so vital to future economic success.

It is within business that the strengths and weaknesses in employability skills are most keenly felt, and for this reason most of the existing contributions to the discussion have come from the perspective of employers, so that the focus is on prioritising the qualities that employers need to see in new recruits.

In fact, at its heart, the whole notion of 'employability' concerns students and their future careers: it is about equipping students to contribute effectively as members

of the future workforce. This guide adopts such a student-centric view, not because of any desire to move business needs away from centre stage, but for the very practical reason that, in order to close the gap in employability skills, we must focus on the experiences of students in universities and colleges. In particular, we recognise that today's graduates are much more likely than previous generations to change career direction several times during their careers. The preparation that students receive at university must take a similarly long-term view.

We intend for this guide to encourage the strong and broad engagement between HEIs and business, in working to understand what employability entails and how best to build it into the education of future graduates. Previous studies and discussions of employability skills have often been narrow in outlook and on a short timescale. We put forward here a broader and less restricted concept of employability, which recognises that our graduates will be living in an increasingly global workplace: they will require adaptability and flexibility in order to contribute real value over their working lives to the organisations for which they work.

ACTION GUIDE

The following Action Guide is based on evidence from existing initiatives, the needs of employers and students, and on our own experience. It comprises recommendations to HEIs for the Delivery and Content of employability initiatives within the curriculum. Each HEI will develop its particular employability offering by constructing a detailed Action Plan, building on its own strengths and those of its external partners. We recommend that in doing so they should seek to incorporate as many of the features of the Action Guide as possible in their circumstances.

ACTION GUIDE PART A: DELIVERY

1. Embed the development of employability skills within the broader curriculum. Do not disconnect them from the development of subject-specific skills.
2. Identify employability 'champions' within each academic department and provide them with the resources and support to plan and coordinate new activities, including the substantial task of creating working relationships with other departments and with local business organisations.
3. Encourage and develop the direct face-to-face involvement of local companies. Some activities around which they can be engaged are discussed in subsequent sections.
4. Involve students themselves in organising employability-related activities. Companies often respond positively to direct contact from students and for students to take some of the initiative on themselves is itself developing an important employability skill.
5. Use IT infrastructure to extend benefits more widely. For example, industrialists could deliver seminars remotely, even to a number of universities simultaneously, and sessions could be recorded for later viewing by larger groups of students.
6. Include early-stage companies in the planning of activities, for example spin-outs from the 'home' HEI. Developing an entrepreneurial outlook is becoming an increasingly important employability skill.
7. Develop appropriate means of assessing students' progress and recognise that a broader approach will be needed than in other parts of curriculum. Successful activities tend to use combinations of formal self-reflection, peer review (especially of work in teams) and presentations.
8. Develop a process for maintaining contact with alumni and their employers over the long term, so that HEIs receive the advice and input they need to remain effective and relevant in a changing business environment.
9. Maintain a record of progress against the HEI's own Action Plan and the elements laid out in this Action Guide. A questionnaire has been developed that can be used by HEIs, and adapted to suit their individual needs.

The questionnaire is available at <http://www.hestem.ac.uk/activity/practical-guide-employability-skills>.

ACTION GUIDE PART B: CONTENT

1. Develop a mix of content, designed to address a variety of challenges faced by companies, alongside wider societal challenges.
2. Make extensive use of role play. Create scenarios that capture the representative complexity of real-life situations, where scientific contributions are also needed from other STEM areas and/or where there are wider issues to take into account such as political climate or public opinion.
3. Use real-life examples to create student exercises. These examples need to be clearly documented and available in the public domain. They might include public enquiries or other intense policy debates ahead of major infrastructure projects, such as Heathrow T5 or High Speed Rail 2, evidence to Parliamentary Committees on science and technology issues, and examples of the use (or misuse) of scientific evidence in the Courts.
4. Connect to the 'big issues' that will be around for several decades: transport infrastructure, new nuclear build, climate change, ageing population, sustainability, etc.
5. Put students in the role of scientific advisers. Look at cases where scientific advisers to government and their colleagues have been prominent in creating policy or responding to emergencies. Examples might include such issues as the risk of volcanic ash clouds to aircraft, the response to outbreaks of foot-and-mouth disease or swine flu, or the public attitude to genetically modified food.
6. Add an international dimension by taking some of the above issues and making explicit comparison with approaches in other countries. For example, Japan sees domestic robots as an important future element of support for an ageing population. Could such a solution be adopted in the UK?
7. Recognise that business-focussed content will often need to be representative rather than real, for reasons of corporate confidentiality. Try to retain as much of the original multidisciplinary as possible.
8. Engage with companies to provide students with exposure to the role of STEM in product life-cycles, innovation cycles, and business planning. Put these issues in the context of the supply and demand for products and services, and the importance of supply chains.
9. Look for company partners that cover a widely varying range of timescales, from the start-up striving to create a first-mover advantage, to an aerospace or pharmaceutical company who must support and develop products over several decades.

The remainder of this report puts our Action Guide in the context of wider thinking on employability, and highlights some examples of current good practice. We show how connecting employability with preparation for lifelong working delivers the best long-term outcome for students and for business.

CONTEXT AND PROBLEM-BASED LEARNING IN CHEMISTRY



The Royal Society of Chemistry has produced a set of case studies that highlight real-world applications of the skills, techniques and understanding that students develop during their undergraduate courses [8].

The emphasis is on close integration with other teaching, and giving students the flexibility, for example, to design experiments rather than just execute a supplied 'recipe'. Different case studies are targeted at different stages of the degree course, depending on the level of subject-specific knowledge that is required. Each one requires the application of this knowledge in a wider context. Examples include identifying active ingredients in natural remedies, planning an industrial chemical plant, responding to a serious incident of river pollution, and the forensic investigation of a sudden suspicious death.

Experiences with this approach confirm the value of using IT to support student collaboration, using poster and oral presentations and peer review for assessment, and using postgraduate students as facilitators.

PERSPECTIVES ON EMPLOYABILITY

We have already noted the predominance of the employer-centric view of employability in previous work. There are several thorough and wide-ranging studies from the perspective of employers, notably from the leading employer organisations such as the CBI. Employer-based studies naturally adopt the timescales of business planning, which vary from sector to sector, but are rarely beyond five years, except in industries with very long design cycles such as pharmaceuticals or aerospace. On these timescales, there is often an emphasis on the need for HEIs to produce increasing numbers of graduates in STEM subjects. For example, the CBI has called for a 40% increase in STEM graduates between 2010 and 2017 [1]. Coupled to this expansion in numbers, employers wish to see also an increase in quality, through enhancement of the skills that enable graduates to contribute value more quickly or at a higher level after they start work.

These conclusions are based on extensive evidence and provide an important focus for the short term. They address, for example, the needs of companies, seeking to recruit the people who will be able to give them a competitive edge in developing the next new product or creating the next new market. For companies of all sizes, success in recruitment is central to implementing their business plans, but also a process that carries considerable risk. By highlighting the skills that they need, employers can help to reduce that risk.

We do not wish to diminish the importance of short-term priorities, but we do wish to emphasize the importance of also getting the right approach for the long term. The working life of a new graduate is likely to be at least 30-40 years, and it may well be that 50 years or more becomes the norm over the next few decades (reflecting improvements in health, reductions in mortality and the economic realities for pensions and retirement that these trends bring with them). HEIs need to prepare graduates for a lifetime (or at least most of a lifetime) of work. Moreover, the career paths of new graduates will become less dependent on the jobs that they take up immediately after graduation. Employability does not refer solely to the ease or otherwise with which a student can land that all-important first job. Changes of direction in career will become more common, and students must therefore be equipped with the skills that will create opportunities for them and enable them to make the right decisions in the long term.

There will, furthermore, be increasing numbers of graduates who will establish their own companies at some point during their careers. Already, it is not uncommon for students to take their first steps in creating new companies while still at university. Employability skills should involve aspects of entrepreneurship, helping prepare students to be effective employers as well as effective employees. Involving early-stage companies, in particular recent spin-outs from the same HEI, will give a valuable added dimension to the development of employability skills.

The final element of our view of employability is a geographical one. The heavy interconnectedness of the business world internationally means that many more graduates than in the past will experience strong international elements in their future employment. For many companies, the ability to operate in international markets or as part of global supply chains is fundamental to their future. Graduates who are able to work across national boundaries will be valued more highly and have many more opportunities open to them.

For all these reasons, we choose to emphasize a student-centric view of employability, which recognises that new graduates are entering a world of employment that has much greater geographical reach and much longer duration than has been the case for previous generations. We need to understand employability skills in this context. Listening and responding to the needs of employers in the short term will remain part of the offering from HEIs, but

the lasting return on investment in higher education will be made over much longer periods of time in ways that cannot be easily predicted from a vantage point several decades away. The task of HEIs is to equip students with the employability skills that will enable them to be successful in this more diverse and dynamic workplace,

no matter what twists, turns and opportunities might be thrown at them along the way. In summary, we retain the notion that employability is the ability to add value to the organisations for which one works, but we place this definition in a much broader setting than has generally been the case hitherto.

DEFINING EMPLOYABILITY SKILLS

To make progress towards practical steps that will enhance employability, it is necessary to match one's view of what constitutes employability with a set of associated skills. We argue for a tight integration of employability skills with the university curriculum, meaning in particular that they are developed through activities that also develop technical competence in STEM disciplines.

To provide a point of reference, we look first at the results that have been reached by adopting an employer-centric viewpoint. Even here, with a relatively narrow notion of employability that highlights the immediate priorities of employers, there are significant variations in opinion as to what constitutes an ideal set of employability skills. *The Employability Challenge* [2], published in 2009 by the UK Commission for Employment and Skills, identifies no fewer than 20 different definitions. The CBI, in its 2010 publication *Ready to Grow: Business Priorities for Education and Skills* [3], sets out the list shown in Figure 1, which we use here as being typical of the various definitions. The CBI and National Union of Students use the same list in their joint 2011 publication *Working Towards your Future: Making the Most of your Time in Higher Education* [4].

If we take this list as a starting point, then in response to taking our broader view of employability, there are two major modifications that are needed.

1. The first is to recognise that a STEM student's main preoccupation at university is to acquire knowledge, understanding and associated technical skills in their

chosen discipline of study. Employability skills should be developed within this context, otherwise they become separated from the bulk of the student's work and therefore risk being marginalised, both in their delivery and in the minds of students. One way of thinking about this point is that universities should view themselves as producing 'employable engineers', 'employable physicists', and 'employable mathematicians', rather than engineers, physicists and mathematicians who have all been exposed to some generic bolt-on set of activities labelled 'employability'.

2. The second modification to the employer-centric list of skills reflects the 'whole-life' aspect of student-centric employability, by including personal qualities that are needed in order to contribute successfully over long periods of time in a diverse and dynamic workplace. These include confidence, maturity, decision-making and resilience against failure. Although it may be difficult to formally teach such qualities as 'skills', they can certainly be developed through activities within the discipline-based approach that we are advocating.¹

- Self-management
- Team-working
- Business and customer awareness
- Problem-solving
- Communication and literacy
- Application of numeracy
- Application of IT

Figure 1: Employer-centric employability skills

¹ Some studies have included honesty and integrity as employability skills. We prefer to treat these as personal qualities that should be instilled well before a young person reaches higher education.



THE CONSTRUCTIONARIUM

Constructionarium enables the next generation of civil engineers to put their HEI-based learning into context on site. Construction companies and consultants collaborate with teams of students in building scaled versions of some of the most iconic bridges, buildings and dams from the UK and overseas.

Constructionarium [9] is located at the National Construction College in King's Lynn. Having been initiated by Imperial College in 2003, over the course of an academic year it now hosts around 15 universities and their respective industry collaborators, for periods of 6 days each on site. In that time, students are put firmly in the role of project managers and decision-makers, to see a project through from start to finish. Assessment emphasizes successful completion within timeframe and budget. Teams must negotiate the supply and delivery of materials on to site, and so are exposed also to the challenges of contract negotiation and management. No single university could provide such opportunities, but by collaborating across a discipline, the student experience is transformed. Further reading: *The Constructionarium and the Art of Contract Negotiation*, Alison Ahearn (2007) [10].

In addition to building these ideas into a list of employability skills, there is some further adjustment needed to the CBI list to tailor it for use by HEIs, specifically the removal of skills that are developed primarily in schools: 'literacy', 'application of numeracy', in the sense of manipulation of numbers, and 'application of IT', in the sense of familiarity with word processing, spreadsheets and internet search. We then reach the following new list of student-centric employability skills, which we take as the basis for the remainder of this Guide:

- a** Self-management
- b** Team-working
- c** Business and customer awareness
- d** Problem-solving
- e** Communication
- f** Confidence / maturity
- g** Decision-making
- h** Resilience against failure
- i** Flexibility and adaptability
- j** International awareness
- k** Entrepreneurial outlook

all to be developed in the context of strong technical skills in the chosen discipline.

Figure 2: Student-centric employability skills

In summary, HEIs should strive to develop a set of strong technical skills in the student's chosen subject of study, coupled to a set of nontechnical skills that, when all taken together, ensure that new graduates will be best equipped to succeed in the workplace. Regardless of whether one builds employability around the business requirements of employers or the career requirements of students, there is agreement on many of the skills involved. But by taking a student-centric view, we are led towards

- (i) closer integration with the core, subject-specific material that is the main purpose of university study, and
- (ii) inclusion of skills that recognise the life-long nature of employability rather than focus on the short term immediately after graduation.

As we shall see below, developing employability skills is often most effective when done with the direct collaboration of industry and business. Taking a student-centric view of employability does not diminish the importance of engaging with employers. Instead, it encourages companies to adopt a similar long-term view, which will lead to a wider engagement at multiple levels within their management structures.

MATHEMATICAL MODELLING WEEKS



The University of Bath is incorporating Modelling Weeks into its undergraduate mathematics courses. Their format will be based upon the Study Groups with Industry [11], which at postgraduate level have been part of the mathematical landscape in the UK for over 40 years.

At the beginning of the week, the students are presented with several real industrial problems. Under guidance from experienced facilitators (lecturers or postdoctoral researchers), they split into groups in order to clarify first the nature of the solution required, and the areas of mathematics that are relevant. They then try various approaches, discarding those that do not work and developing further those that show most promise. Students take responsibility for different parts of the solution, within the context of the overall effort. This activity runs in parallel for each of the problems under consideration and at the end of the week the conclusions are gathered in writing and presented to the full group.

GROUP INDUSTRIAL PROJECTS IN PHYSICS



The Institute of Physics is working with 15 physics departments to develop undergraduate group projects with local companies and public sector organisations. The initiative is building on a programme that has been running successfully at the University of Durham for over 20 years [12].

The aims of these projects are to promote stronger links between universities and employers and to match graduate skills with employer needs. The projects are carried out in university laboratories and could, for example, involve building a piece of equipment, testing a product or designing a control system. The students are guided by a member of academic staff, but are expected to evolve their own approaches to the problem. Liaison with their industrial 'client' includes visits, for example to use specialist equipment, and presentations of the results to the company at the end of the project. The students learn how to work effectively as a team, how to organise themselves and how to communicate their work in writing and orally, as part of the final assessment.

BUILDING EMPLOYABILITY INTO THE CURRICULUM

Employability should be developed within existing curricula. As noted above, HEIs should produce ‘employable engineers’, ‘employable physicists’, and ‘employable mathematicians’. This does not mean that there needs to be inefficiency of delivery through duplication, but it does mean that employability must be developed within its proper, subject-specific context.

The next point to bear in mind is that, even setting aside the subject-specific aspects, employability skills are of little use in isolation. A modular approach will not work. Success in the workplace will depend on developing and applying these skills in combination. Universities should design activities that can be delivered in a subject-specific context, to target various combinations of skills. There should be very active student engagement: activities will often take the form of a task or short project. The four side boxes in this report highlight examples of current good practice drawn from different STEM disciplines. The best activities will create an environment in which success depends on developing and using employability skills in combination. They should also bring into sharp focus how the skills on our list are required to derive greatest value from the core subject-specific skills.

In *Engineering Graduates for Industry* [5], published in 2010, the Royal Academy of Engineering put forward a range of activities that universities can adopt as a means of building employability into the curriculum. They were brought together under the slogan ‘relevance motivates’:

- Sponsored programmes;
- Project-based and other forms of active learning;
- Industrial group projects;
- Lectures / seminars from engineers in industry;
- Case studies from industry;
- Site visits and field trips;
- National and international competitions.

These ideas are all potentially useful, but many do not have the active engagement that leads to greatest benefit.

One activity with very high demands on student engagement is ‘work experience’, which is widely cited as an effective way of developing employability skills. In fact, evidence for the benefit of experiential learning is fragmented. See the *Review of Evidence on Best Practice in Teaching and Assessing Employability Skills* [6], published in 2008 by the UK Commission for Employment and Skills. To be effective, it needs to be clear what activity is contained within a period of ‘work experience’, which combination of employability skills it addresses, and how. When done well, internships or industrial placements can be highly effective. For example, at the postgraduate level, the Industrial Mathematics Knowledge Transfer Network has developed a successful internship programme in collaboration with industry, universities, Research Councils and the Technology Strategy Board [7]. They require significant joint investment of time and resources, but can add a whole new dimension to the STEM curriculum. The set-up costs can be greatly reduced by exploiting as far as possible existing relationships with companies, and also by sharing infrastructure across academic departments and even across institutions.

ASSESSING PROGRESS

There are two distinct assessments to carry out in respect of employability initiatives: first, the performance demonstrated by students participating in activities; secondly, the extent to which these activities close the employability gap for employers and provide a foundation for students’ future success.

ASSESSING THE WORK OF STUDENTS

Assessment of performance on employability activities needs careful attention, but ultimately is little more than an extension of the ways in which assessment and examination of subject-specific knowledge takes place at present. The key point here is to reflect in the assessment the broader context in which employability skills are most usefully developed. As usual, students will achieve varying degrees of success, but there are no ‘model’ solutions as such. Assessment should take place in a correspondingly broad context. It can usefully involve peer review and an element of self-assessment, as well as the feedback and views of industrial and academic domain experts. There is frequently a presentation of some sort at the end of an exercise or activity, which can be used to bring together these various elements.

Assessment can be facilitated by making explicit connection between the elements of the activity and the employability skills that it targets, and also to design activities that have high degrees of active student engagement if they are to be completed successfully. Activities should give each student an opportunity to demonstrate their individual contribution to what will often be a team effort. If activity of a similar type is undertaken more than once during an undergraduate career, then the improvement over time can also be assessed.

ASSESSMENT OF ACTIVITIES

Assessing the efficacy of employability activities, in terms of the value generated by students after they have entered the world of work, is much more ambitious. We make suggestions below for a practicable approach.

It is a common view, articulated in many surveys and investigations, that assessing employability in any objective way is difficult. This problem is greater if one adopts the

usual employer perspective, where the difficulty largely reflects the wide diversity of employer requirements, hidden beneath an agreed set of generic employability skills. It is a further difficulty that employability tends to be assessed by looking at the skills of new recruits, which are influenced by a myriad of other factors, some internal to the company, such as the salaries and career prospects on offer, and others external, such as the prevailing level of competition for jobs among graduates.

What approaches are possible that reflect the longer-term view of employability that we advocate here? We need to look beyond the direct educational provision of our universities regionally or nationally, and ask what is their influence more widely, through the graduates that they produce. Put another way, how valuable are our graduates to the organisations for which they work, compared to other graduates both from the UK and overseas? We deliberately emphasize the international aspect here. The 21st Century workforce is extremely mobile, allowing companies to draw expertise from around the globe and universities must look at the employability of their graduates in an international context.

Remember that we think of employability as the ability to add value in the workplace. We can assess this in terms of the positions of influence that individuals achieve within their organisations, on the assumption that organisations tend to promote their most valuable people to positions of greater influence.

We therefore recommend that universities should extend their relationships with employers and also with graduates themselves, in order to build up a picture of career progression into positions of increasing influence. There could be a focus on a small group of employers, provided they are companies with sufficient breadth of opportunity for employees to progress. In STEM subjects,

natural candidates might be drawn from existing research collaborators, thereby adding a new dimension to an established relationship. The objective is to gather data on how an HEI's own graduates progress compared to those from other regional, national and international institutions. Maintaining a regular dialogue with former students and their managers will in addition help to understand the extent to which employability activities that were undertaken while a student help either to accelerate career progression or to open up new career paths in an organisation.

This is a long-term task, but one that provides for valuable and regular dialogue at a strategic level between HEIs and employers. Moreover, as companies evolve or change their market focus, these interactions inform the adaptation of employability activities to changing business needs. In circumstances where former students progress to running their own companies, they are particularly well placed to advise on evolving employability needs. HEIs should seek to exploit all these opportunities to strengthen their provision through their alumni.

CONCLUSION

Our key conclusions and recommendations are as follows.

- The varied and unpredictable career paths of today's business world are best served by a student-centric approach to employability, which prepares graduates to make effective contributions over several decades.
- Employability skills cover self-management, team-working, business and customer awareness, problem-solving, communication, confidence/maturity, decision-making, resilience against failure, flexibility/adaptability, international awareness and an entrepreneurial outlook. They should be integrated within the curriculum and developed through activities that also require technical ability in the student's chosen discipline.
- We have created an Action Guide for effective provision, which we recommend that HEIs use as a checklist when designing the delivery and content of employability activities.
- HEIs should work closely with their external partners and with their alumni, and be prepared to do so over extended periods, in order to ensure that employability activities are effective and can adapt to evolving business needs.

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