

A Joint Educational Framework for Incorporating Employability and Enterprise in the Engineering Curriculum: Ongoing Developments

¹Philip Tranter, ¹Martin R. Varley, ²Julie Hardy, ²Peter J. Sewell, ²Lorraine Dacre Pool, ²David Bagley, ³Fang Xiaodong, ²Jenny Shi, ¹John A. Calderbank

¹ School of Computing, Engineering and Physical Sciences,
University of Central Lancashire, Preston, UK

ptranter@uclan.ac.uk, mrvarley@uclan.ac.uk, jacalderbank@uclan.ac.uk

² Futures: Employability, Enterprise and Careers Support
University of Central Lancashire, Preston, UK

jhardy@uclan.ac.uk, pjsewell@uclan.ac.uk, ldacre-pool@uclan.ac.uk,
dbagley@uclan.ac.uk, jshi5@uclan.ac.uk

³ Innovation and Entrepreneurship Park
Xiamen University of Technology, PR China
fangxiaodong@xmut.edu.cn

Abstract

Recognising the importance of employability, enterprise and entrepreneurship for Engineering graduates, teams at the University of Central Lancashire (UK) and Xiamen University of Technology (PR China) are working collaboratively on a joint educational framework for the development of enterprising engineers. The considerable synergies between the two institutions, especially in terms of their respective approaches to embedding aspects of employability and entrepreneurship skills into the curriculum, and inspiring the students to engage with these, have led to this exciting opportunity to work together to the mutual benefits of their students and graduates. This is a two year British Council funded project, the intention of which is to identify, share and develop the best features of our respective models for addressing employability issues with undergraduate students, including inventive problem solving, emotional intelligence, career development learning, experience, specialist and generic skills, project work etc.

The project has now moved into its second year of operation, and the main focus of this paper is to discuss the progress and achievements to date, and present further developments. Much of the project's first year of productivity has been directed towards the investigative work necessary to provide a robust basis for the development of the new framework. Achievements include the development of an 'employability mapping tool' to gain an accurate overview of the current level and depth of employability and enterprise provision within our respective engineering programmes, a 'gap analysis' survey to gauge the opinions of our current engineering students, and a survey of previous graduates to identify the skills and abilities that they felt to be of importance in their current professional role. A key development which directly involves current undergraduate Engineering students from both institutions has been developed and introduced for the first time this year, in the form of an international design competition. It was very interesting to observe the students rise to the challenge presented, and each group came up with original concept along with a good level of underlying depth for the design of their product. Details of this aspect of the project are included in this paper.

1. Introduction

In this paper, we describe a collaborative (UK-China) project between the University of Central Lancashire, UK (UCLan) and Xiamen University of Technology, PR China (XMUT). Traditional taught undergraduate engineering courses often focus on the technical aspects of work across an appropriate range of subject-specific areas. This in itself is seen as a good thing, in that students graduating with a particular degree title have knowledge, skills and experience in the relevant areas, leading to competence, confidence and employability. However, we recognise that this can leave little room in the curriculum for addressing the more generic, 'softer' skills, required or expected by potential employers. The project is aimed at identifying ways in which these 'soft' skills can be introduced to engineering students, with a view to encouraging them to recognise, develop, and nurture these skills alongside the more traditional content of their engineering courses.

This is a two year British Council funded project, currently in its second year of operation. The initial context and definition of the project were presented in a previous paper at the ICEE-2010 conference [1]. This paper summarises some of these earlier aspects of the work, then goes on to present further developments made during academic year 2010-11, including various information-finding aspects such as surveys of students, alumni, and employers, and students working on group design exercises, in which groups of current students from each institution were asked to design a commercially viable mobile application for the market of the other country. It was very interesting to observe the engagement of the students, with each group carrying out thorough market research for their idea, and developing the concepts. Some details of this aspect of the project, including work carried out by groups of students from both institutions, are included in this paper.

2. Project Background and Previous Work

This section briefly discusses the institutions involved, the background of the project, and the employability models developed independently by the two institutions. Further details of these aspects were previously presented in an ICEE-2010 paper [1].

2.1 Shared Goal for UCLan / XMUT Partnership

The shared goal of the partnership is to design a joint educational framework for the development of enterprising engineers using the XMUT model incorporating inventive problem-solving, and the UCLan 'CareerEDGE' model incorporating emotional intelligence. The framework will therefore incorporate key elements of the research findings and teaching and learning methodologies from both universities, enabling evaluation and implementation across institutions and cultures. This will provide a conceptual model to assist in strategic decision-making. It is anticipated that this will also facilitate operational improvements in course delivery at both institutions, making the whole greater than the sum of the parts.

2.2 Brief Institutional Overviews of UCLan and XMUT

The University of Central Lancashire (UCLan) is a large, modern University which is at the leading edge in developing student employability and enterprise in the UK. UCLan's main campus is situated in Preston in the north-west of England, with other campuses in Burnley (east Lancashire) and Westlakes (west Cumbria). An organisational unit, known as 'Futures', comprises over 50 dedicated staff and provides employability, enterprise and careers support. UCLan's employability-related work has been recognised for its excellence over many years: UCLan was awarded £1 million under the Enterprise in Higher Education initiative in 1991, and more recently in 2005 UCLan was awarded nearly £5 million and designated a National Centre for Excellence in Teaching and Learning (CETL) for Employability in the Humanities. UCLan is now the lead in the University Enterprise Network (Nuclear) supported by the National Council

for Graduate Entrepreneurship (NCGE) and is a national leader in supporting graduates' new business start-ups. UCLan's strategy is to encourage students to develop their understanding of Business Enterprise and Entrepreneurship in order to enhance their future career options and opportunities. UCLan has a long established and extremely successful record of partnerships in China which began in the 1980s under the British Council's Academic Links with China Scheme. The first links were established with Guangdong University of Foreign Studies in 1986, and soon after with Shenzhen University in Engineering. A structured programme of teaching staff exchanges and secondments started in the early 1990s and to-date over 120 staff have participated in such exchanges. The School of Computing, Engineering and Physical Sciences (CEPS) pioneered joint courses in China, and now runs a number of such joint courses in Engineering with institutions in Shenzhen and Beijing. A collaborative PhD programme is also in operation with North China University of Technology (NCUT) in Beijing. Some of the UCLan staff involved in these collaborative undergraduate and postgraduate programmes are also involved in this joint employability project with XMUT.

Xiamen University of Technology (XMUT) is situated at the heart of the Xiamen Special Economic Zone, and has roots extending back to 1981. XMUT now has two campuses, Siming and Jimei, a total enrolment of almost 17,000 students and is dedicated to meeting the social and economic needs of the region. XMUT offers 40 separate, four-year bachelor programmes focusing on advanced and specialist engineering. It prides itself on being a 'cradle for talents for local training' and works intensively in partnership with regional enterprises to fulfil business expectations, guided by senior professionals from within the work-based community. The core of XMUT's future vision is to develop highly-skilled, work-ready graduates, and already 90% of XMUT's students secure high level employment within months of leaving the university. XMUT's courses incorporate strands of world-class employability embedded within and throughout the curriculum. The city of Xiamen hosts the annual China International Fair for Investment and Trade which attracts enormous foreign capital to the area and helps to secure the region's position through fostering an entrepreneurial spirit. XMUT itself mirrors this ethos through initiatives such as the Innovation and Entrepreneurship Park, which cultivates the innovative abilities and professional competences of student entrepreneurs. Students can build upon their business knowledge, launch projects and incubate their business ventures in a creative and supportive environment.

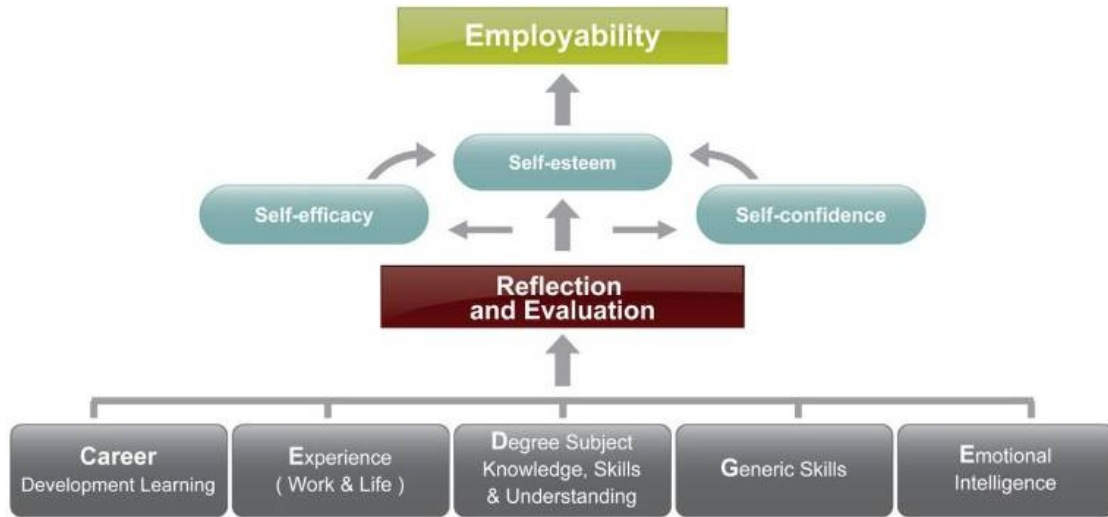
2.3 Definition of Terms: Employability, Enterprise and Entrepreneurship

Since definitions of these terms may vary in different contexts, and also these may become confused when translated into Mandarin, the definitions below [1] are used throughout this project:

- **Employability:** "having a set of skills, knowledge, understanding and personal attributes that make a person more likely to choose and secure occupations in which they can be satisfied and successful" [2]. For engineering graduates and employees in particular, 'employability' should also encompass the ability to use new technologies, and commercial awareness.
- **Enterprise:** Rae [3] suggests that this set of enterprise skills includes: initiative, problem solving, identifying and working on opportunities, leadership, acting resourcefully, and responding to challenges.
- **Entrepreneurship:** "the desire, motivation and skills necessary to start and manage a successful business" [4].

2.4 Employability Models

The UCLan 'CareerEDGE' employability model shown in Figure 1 provides a clear framework for exploration and discussion of the variables and their interrelationships in seminars with colleagues, facilitating exploration of the key concepts.



Dacre Pool & Sewell (2007)

Figure 1 UCLan 'CareerEDGE' employability model [5]

The employability model developed by XMUT, and summarised in Figure 2, provides a robust educational framework for the delivery of academic, business-focussed and innovation-led aspects contributing to the development of enterprising graduates. A key element of this framework is the inclusion of Inventive Problem Solving which underpins much of the project-based learning.



Figure 2 XMUT employability model [1]

3. Initial Investigations

Some aspects of work carried out for this collaborative project are summarised below. These will provide the basis for the development of the new framework. In many cases these are ongoing, such that initial surveys have been carried out and the results are currently being collated and analysed at the time of writing.

3.1 Employability Mapping Tool

We began by using an 'Employability Mapping Tool' [6] in order to gain an accurate overview of the current level and depth of employability and enterprise provision within our respective engineering programmes. UCLan's Electronic and Computer Engineering (ECE) programme was the focus of this exercise and aspects of the course provision were scrutinised for employability skills development, career development learning and overall ethical and global awareness. The mapping tool covered the following areas:

- **Course Attributes:** This section included academic excellence, global awareness, and ethical awareness.
- **Enterprise:** Aspects such as students' creative approaches to problem solving, opportunities for students to take the initiative, identifying opportunities and developing strategic approaches towards capitalising on them, were included in this section.
- **Employability:** Various aspects were considered including career development learning, experience (work/life), degree subject knowledge, generic skills, and emotional intelligence.
- **Skills Development:** This section explored the extent to which students perceived that they are offered the opportunity to enhance specific employability-related skills within their taught modules and their courses. Students were asked to consider whether the following aspects are taught, practised, assessed or not relevant: personal development, communication skills, research skills, team working, reflection, project management, business skills, problem solving, creative thinking, industry or sector-specific skills, numeracy and literacy.

The Employability Mapping Tool developed for this project has been adopted for use across UCLan, and a number of other institutions have expressed interest in using it.

3.2 Employability Development Profile

The next stage was to conduct a survey to gauge the opinions of our current engineering students. This survey took the form of a 'gap analysis' using UCLan's Employability Development Profile [7] based on the CareerEDGE employability model. Sample data was collected from the first, second and final year students from the ECE programme at UCLan, to ascertain the perceived levels of employability-related learning contained within the course. The questionnaire included 28 questions under the following categories: career development learning, experience (work/life), degree subject knowledge, generic skills, and emotional intelligence. Students were also asked to consider their responses to the questions in terms of employment, how to improve their skills in certain areas, etc.

3.3 Survey of previous graduates

An alumni survey was then carried out. The nature and type of questions contained within the survey questionnaire was informed by conducting a series of preliminary discussions with graduates which aimed to reveal the skills and abilities that they felt to be of importance in their current role. Areas covered in these initial and the resulting questionnaire included overall career development, the importance, assessment and development of a range of employability skills, which skills were particularly valued by their employers, and whether

their skills had been taught at university, or developed 'on the job'. The questionnaire included a detailed list of specific skills, and graduates were asked to consider the importance of these skills, assess their own personal abilities in these areas, and how these had been developed during their degree studies and subsequent employment. For skills addressed during degree studies, graduates were asked to consider if, and to what extent, they understood why they were being taught these skills as part of their degree.

3.4 Survey of local businesses

The final part of this investigative stage was to conduct a small-scale survey of businesses in the region. Using data provided by the Chamber of Commerce, employers of engineering graduates were telephone-interviewed and asked a series of questions about the employability-related strengths and weaknesses of their graduate staff and the skills and abilities most useful to them as employers. This aspect of the work was also mirrored in China, with a survey of entrepreneurs and their representatives, to seek their views on the skills expected and required for the graduates that they may wish to employ.

The student, alumni and employer surveys were jointly designed and developed by staff from UCLan and XMUT, but differed slightly in content and tone in order to be appropriate for their intended audience.

4. Group Design Project

Students from both institutions were invited to enter the 'Futures International Design Competition', in which groups of 3 or 4 students were tasked to consider, develop and present concepts for a 'Mobile Application Design for an International Market'. On this occasion this was an extra-curricular activity, although in future years we will consider embedding such an exercise into one of the taught modules. Each UK team was asked to design a commercially viable mobile application for the Chinese market, whilst the Chinese teams designed a commercially viable mobile application for the UK market. Students were not required to write the software to support their applications, but they were asked to consider and demonstrate considerable understanding of the user interaction protocols that would need to be in place to facilitate its operation.

This exercise lasted about six weeks, after which the student groups presented their findings for their application in a 'pitch' style presentation, to an audience including some of their peers, lecturers, and a panel of four international business people. Each group came up with ideas that were very well thought out, from the basic concept, through research into the international market and financial and technical considerations and decisions including the choice of platform and costs to the user, to a final presentation to put across their ideas. Ideas included gaming applications with novel aspects (e.g. 'social gaming'), shopping apps, 'HyperVoiceIE', and software installation aids. These presentations were well received and stimulated some interesting discussions with the panel and audience. Title slides from the presentations from the four UCLan groups are shown in Figure 3.

Throughout this short exercise, it was very interesting to observe the changes in the students' approach and attitude, particularly as this exercise was being carried out during a period which was already busy for students (March-April 2011). It was clear that the challenge had captured their imaginations, and thereby motivated them to engage with this work, and develop key employability and entrepreneurship skills alongside the technical skills developed during their studies.

Each institution had a judging panel who discussed the students' ideas with them, and finally identified a winning team from each institution. The winning team from UCLan had put forward their ideas for a 'Chinese Food App' (Figure 3c [10]) to help visitors to a new country locate and book a restaurant to suit their tastes and requirements, whilst the XMUT winners had developed concepts for 'HyperVoiceIE', software using voice prompts to control an application browser. We propose that the UK winning team members should visit XMUT (and vice versa) in order to get firsthand experience of the international market they had been researching, and possibly develop their ideas further. Funding is currently being sought to facilitate this.



Figure 3 Title slides of group presentations from UCLan students:

- (a) Parallel Worlds: [8]
- (b) Tag Man [9]
- (c) Chinese Food App [10]
- (d) Luxury Brand Goods Locator [11]

5. Concluding Remarks

The teams at UCLan and XMUT are fully committed to ensuring the success of this project and it has received support at the highest levels in both our universities. Staff visits between institutions have been extremely productive and provided both parties with the opportunity to exchange ideas and information. We are in regular contact with each other and have each provided help and support throughout the course of the project. Both our universities display high levels of success in graduate employability and have placed the further development of

Employability and Entrepreneurship at the centre of our strategic development plans. Further activities envisaged for the future include:

- creating and piloting a new joint module for both institutions addressing employability with a practical engineering context,
- designing and implementing further competitive activities between groups of students on undergraduate engineering courses at each university,
- establishing a joint website to house information about the project, which will act as a means of showcasing and disseminating the ongoing employability-related research that our institutions are involved with,
- further dissemination of the work including engineering education conferences and holding a significant conference in China (2011/2012) to present our findings, and to compare experiences with other universities.

6. Acknowledgement

This two-year Project is funded under the Prime Minister's Initiative (PMI) Fund 'China-UK Collaborative Partnerships in Employability and Entrepreneurship 2009-2010' from the British Council and Education UK: 'Establishing Connections PMI2 Connect'.

References

1. M.R. Varley, J. Hardy, P.J. Sewell, L. Dacre Pool, D. Bagley, X. Fang, P. Tranter, J. Shi and J.A. Calderbank, "A Developing Joint Educational Framework for Incorporating Employability and Enterprise in the Engineering Curriculum", *International Conference on Engineering Education 2010 (ICEE-2010)*, Gliwice, Poland, July 2010.
2. Pedagogy for Employability Group, *Pedagogy for Employability*, The Higher Education Academy, York, 2006, pp.4.
3. D. Rae, "Connecting enterprise and graduate employability. Challenges to the higher education culture and curriculum?", *Education + Training*, 49, (8/9), 2007, pp.605-619.
4. P. Sewell and L. Dacre Pool, "Moving from conceptual ambiguity to operational clarity: employability, enterprise and entrepreneurship in higher education", *Education + Training*, 22, (10), 2010, pp.89-94.
5. L. Dacre Pool and P. Sewell, "The key to employability: developing a practical model of graduate employability", *Education + Training*, 49, (4), 2007 pp.277-289.
6. A. Hunter, "The UCLan Employability Mapping Tool", internal UCLan publication, 2010.
7. P. Sewell and L. Dacre Pool, "Measuring employability using the employability development profile" *Association of Graduate Careers Advisory Services (AGCAS) Conference*, Brunel University, UK, 2009.
8. E. Taylor, S. Egan and C. Duerden, "Parallel Worlds: Bringing the Social to Social Gaming" *UCLan Futures International Design Competition presentation*, 15 April 2011.
9. M. Alnefaie, A. Alharthi, I. Musa and P. Gnafakis, "Tag Man", *UCLan Futures International Design Competition presentation*, 15 April 2011.
10. M. Burns, C. Dunster, A. Thornton and R. Kenyon, "Chinese Food App", *UCLan Futures International Design Competition presentation*, 15 April 2011.
11. J. Agbonkhese, A. Tejada, S. Zapatel and A. Barberan, "Luxury Brand Goods Locator", *UCLan Futures International Design Competition presentation*, 15 April 2011.