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A Multidisciplinary Approach to Creating the Entrepreneurial Mindset Amongst Graduates

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Abstract

The aim of this paper is to investigate how one third level college in Ireland has responded to economic change with the development of a multi-disciplinary entrepreneurship programme and to explore its impact on the development of entrepreneurial mind-sets amongst its current students and graduates. The findings are based on results of surveys from twenty graduates from the programme who have come from a cross section of engineering and science disciplines. Findings of this study indicate that a dedicated entrepreneurship programme specifically designed for non-business students has had an overwhelming positive impact on their entrepreneurial attitudes and intentions. In particular, students' understanding of entrepreneurship has been significantly changed since completing the programme, their level of confidence towards starting a business has increased and collectively the group have embraced the culture of entrepreneurship. This paper can provide useful information to academics in developing third level entrepreneurship programmes for non-business disciplines. The study is an innovative example of entrepreneurship education and creates a framework for other third level institutions to develop similar initiatives to help lay the foundations for entrepreneurship to be the norm, and as such will also be of interest to researchers in this space.

Keywords: Collaboration, Engineering, Entrepreneurship, Higher Education, Innovative Practice, Multidisciplinary Education, Pedagogy

Introduction

In recent years, entrepreneurship has been elevated as a topic of importance within the industrial and educational sectors. The business sector is being encouraged to become more entrepreneurial in their endeavours at creating more products and services and in the manner in which they engage and compete. Entrepreneurship has been highlighted as ‘one of the cornerstones of a modern, fully developed economy’ Forfás (2007, p.5). The radically altered economic climate has lent greater urgency to the provision of education that will equip graduates to be entrepreneurial. The Hunt report (2011) on the National Strategy for Higher Education to 2030 in Ireland makes frequent references to the need to develop enterprise and entrepreneurship.

The National Policy Statement on Entrepreneurship for Ireland (2014, p.6) highlights: *‘Entrepreneurship is a key element in the health and wellbeing of any thriving economy and will be central to Ireland’s continuing recovery’*. It also states that, historically, two thirds of new jobs in Ireland have been created by companies in their first five years and that new businesses drive change and are the source of creative ideas and new technologies.

It is now widely accepted that the competitiveness and future prosperity of the Irish economy depends on the application of knowledge, innovation and entrepreneurship. There is a need to provide a sufficient quantity of skills to fill the emergent employment opportunities; to develop entrepreneurial skills which are relevant to all disciplines in an intrapreneurial context. In business, there is a need to provide the quality of skills required to drive growth and provide the diversity of skills to reflect the complexity of business.

There has been a call for entrepreneurship education to be embedded in all courses at third level to help develop and nurture entrepreneurial mind-sets Fitzsimons & O’Gorman (2013). It has been suggested that at third level, programmes should take a multi-disciplinary approach to support the entrepreneurial ideas that emerge outside of business faculties (O’Keeffe, 2013).

Context and Rationale

The Entrepreneurship Forum Report (2014, p.3) states *‘Entrepreneurship is about creating meaningful businesses out of the raw materials of people, ideas and customers. These raw materials need to be forged out of what we have, what we can grow and out of what we can attract to ourselves’*. The report makes recommendations for the people, the businesses and the Government of Ireland on how to build a more dynamic and productive entrepreneurial ecosystem.

One of the key recommendations of this report is for the development of a National Educational Strategy for Entrepreneurship covering all levels of the education system and calls for the establishment of an entrepreneurship education group to draft an entrepreneurship education strategy that embeds teaching of entrepreneurship into primary, secondary and third level schools and colleges.

In the Department of Jobs Enterprise and Innovation (2015, p.46) ‘Action Plan for Jobs’, the Government has set out a vision for Ireland to be among the most entrepreneurial nations in the world and acknowledged as a world-class environment in which to start and grow a business. It is vital that the role of entrepreneurship is optimised as an essential source of employment and wealth creation, thereby positioning entrepreneurship as a key element in the economic growth agenda.

The Economic and Social Research Institute, Quarterly Economic Commentary (Spring 2016, p.1) indicates that on foot of substantial growth performance in 2015, the Irish economy is set to increase by approximately 5 per cent in 2016. The follow on expectation is that as the economy recovers, there will be a renewal in entrepreneurial activity. As a consequence there will be a need for a graduate population with entrepreneurial skills ready to embrace the renewal and participate as entrepreneurs and intrapreneurs. Hisrich *et al.* (2013, p.6) states that entrepreneurship plays an important role in the creation and growth of businesses, as well as in the growth and prosperity of regions and nations, however, they also recommend that in order to recognise, evaluate and exploit opportunities enterprising individuals are required.

The importance of the role of entrepreneurship in higher education is well documented. Botham & Mason (2007, p.9) suggested that the widespread teaching of entrepreneurship is perhaps one of the reasons for the entrepreneurial nature of the United States economy. The call for culture and education to support entrepreneurship in Ireland is recognised in Forfás (2007, p.57). Ideally it suggests that culture and education will be mutually re-enforcing and complementary in fostering a spirit of enterprise throughout society, strengthening the motivation and capacity of entrepreneurs and potential entrepreneurs. The Hunt report (2011, p.56) on the National Strategy for Higher Education to 2030 in Ireland suggests that creativity and entrepreneurship must be encouraged to a much greater extent at undergraduate level.

Entrepreneurship Education

Over a relatively short period of time, entrepreneurship education has been pushed to the top of socio-economic and political agendas, and is currently a high priority imperative for government policy makers throughout the industrially developed and

developing world Mitra & Matlay (2004). With the challenges faced by a globalised economy, it is now recognised that entrepreneurship can have a significant role to play through the promotion of innovation, employment generation and the development of social enterprise and, therefore, entrepreneurship education is deemed of great importance.

In 2010, the OECD re-affirmed the role of entrepreneurship education in supporting economic growth and, in particular, recovery from the recent economic crisis. The first of five stated policy principles to drive innovation was to empower people to innovate. More specifically, it was argued that governments should seek to provide:

- Education and training systems (which) equip people with the foundations to learn and develop the broad range of skills needed for innovation in all of its forms, and with the flexibility to upgrade skills and adapt to changing market conditions;
- Practical experience to promote entrepreneurial mindsets, and;
- Foster an entrepreneurial culture by instilling the skills and attitudes needed for creative enterprise.

It is widely recognised that the benefits of entrepreneurship education are not limited to the creation of new business ventures and subsequent new jobs, but will also develop key competencies of students, encourage innovative mind sets and as a consequence enable them to be more creative and self-confident in whatever they undertake.

Mwasalwiba (2010) reviewed literature on entrepreneurship education and found that the most common definition for entrepreneurship education is that of an educational process designed to influence individuals' attitudes, behavior, values or intention towards entrepreneurship. He found there was relative agreement among academics that

the main rationale for entrepreneurship education is more economic than social, with entrepreneurship being seen as a solution to economic problems, in particular employment. However, there has been a move towards a behavioural view with a focus on entrepreneurship education to influence attitudes, values and a general culture. In this way, scholars are reluctant to associate entrepreneurship education strictly with new venture creation as a sole educational objective. It has been highlighted by Hytti & Kuopusjärvi (2004, p.6) that there is also a distinction between preparing people to be enterprising/entrepreneurial and preparing them to be entrepreneurs.

Universities and third level colleges engage at various levels with the teaching of entrepreneurship. Today most third level colleges have incorporated elements of entrepreneurship in their programmes and modules. The level to which the theme is incorporated depends on the objective. For example, Hegarty & Porter (2010, p.723), suggest that entrepreneurship education has three roles, depending on the context:

- To learn to understand entrepreneurship
- To learn to become entrepreneurial
- To learn to become an entrepreneur

As entrepreneurship plays such a vital role in the development of an economy and the creation of wealth and jobs, the question for the educational sector is how to develop training programmes which will instill the necessary skills in students to allow them to operate as graduates in an entrepreneurial manner. Henry *et al.* (2003, p.196), asserts that at the individual level, students who have completed entrepreneurship programmes are more likely to:

- create more businesses and employment;
- generate more business contacts;
- have a broader range of skills and knowledge;

- possess greater self-confidence in their entrepreneurial abilities;
- test the commercial viability of their idea; and
- improve their employability even if they do not start a business.

The European Commission (2008, p.26) has specified the importance of the development of entrepreneurship education at third level. It suggests that there are features of entrepreneurship education that are common within all disciplines and programmes and courses should be geared to the acquisition of generic and horizontal skills, aimed at making students ‘.... *more creative/innovative; highly motivated; proactive; self-aware; self-confident; willing to challenge; better communicators; decision-makers; leaders; negotiators; networkers; problem solvers; team players; systematic thinkers; less dependent; less risk averse; able to live with uncertainty; capable of recognising opportunities.*’

The same report recognises that the teaching of entrepreneurship needs to be tailored to the specific needs of different fields of study. Botham & Mason (2007, p.10) recognise that while much of entrepreneurship education is in the Business Schools, there has also been a rapid growth in Engineering Schools and increasingly other disciplines.

Volkman (2004, p.185) states that entrepreneurship taught and learned on the basis of an interdisciplinary approach at universities, introduces new forms of knowledge and teaching methods as well as new problem-solving skills for students.

Terms such as “multidisciplinary” and “interdisciplinary” entrepreneurship education are being used to explain models where collaboration occurs between different disciplines. The extent to which the collaboration occurs can range from side by side delivery of lecture material to the total integration of the different disciplines in a programme or a module or a single assignment project. Technological and Business

disciplines are well suited to such collaboration. The World Economic Forum (2009, p.21) suggests that Entrepreneurship needs to be expanded across disciplines - particularly in the technology and science departments, where many innovative ideas and companies originate.

Entrepreneurship Education in an Irish Context

The Irish Government has outlined its commitment to the inclusion of entrepreneurship education within curricula across all sectors (Forfás, 2004). The report states that Education can contribute to creating a more entrepreneurial culture by helping to build a more entrepreneurial mindset among young people. In a follow on report by Forfás (2007, p.65) entrepreneurship, it has been pointed out *'is one of the cornerstones of a modern, fully developed economy'* and the radically altered economic climate has lent greater urgency to the provision of education that will equip graduates to be entrepreneurial.

Cooney & Murray (2008) researched the extent of entrepreneurship education in the third level sector in Ireland. They considered twenty-six third level colleges in Ireland and documented each college's contribution to the teaching of entrepreneurship. They recognised that entrepreneurship education is very much in its infancy in Ireland, however the provision is increasingly available in all third level institutions in the form of business modules and structured academic programmes.

A later report by Tom Martin and Associates (2011, p.60) showed that there was a total of 416 entrepreneurship education modules and 44 entrepreneurship education courses offered by the same higher education institutions. The report also provided a list of entrepreneurship education courses and modules offered by Private Higher Education

Colleges (1 undergraduate course and 20 modules were listed in the 8 colleges surveyed). The report concluded that in the three years since the Cooney & Murray report there was an increasing recognition of Entrepreneurship Education as a substantial subject in higher education. A search of The National Learners website, Qualifax, shows that there are 61 entries under entrepreneurship in the third level sector in Ireland, 33 of which have the word entrepreneurship in the title. Of these 33, 1 is at doctorate level (level 10), 9 are at masters level (level 9), 10 at honours degree level (level 8) and 2 are at ordinary degree level (level 7).

Engineering and Entrepreneurship

According to Lumsdaine & Blinks (2003), typically engineers have a strong preference for analytical, logical, quantitative thinking, often coupled with very structured, procedural thinking. Engineering is ultimately about solving problems, analysing problems and developing solutions. This may be through product design, process design or system design. It may involve change, moving from old to new, for example; a product at the end of its lifecycle being upgraded or being replaced with a new product. It also involves the management of the transition process from old to new. Engineers are expected to recognise the need for change and identify the means to implement that change, in addition to being capable of assessing and managing the impact of change.

International research highlights the benefits of providing entrepreneurship education to those students outside the business school (Hill *et al.*, 2003, European Commission, 2008). There would appear to be an inherent logic in educating students for entrepreneurship in a multi-disciplinary approach, especially for graduates in technical disciplines where self-employment is a traditional outcome. Cooney & Murray (2008,

p.44) suggest that internationally, entrepreneurship or enterprise-based modules are increasingly being incorporated into non-business courses; more significantly, *“interest and demand in these modules is growing among science, engineering, and arts faculties.”*

A study by Berlund & Wennberg (2006) comparing creative abilities of two groups of entrepreneurship students with different backgrounds, one from engineering and the second from business studies, reported that in the creative processes, the engineering students tended to stress the role of action and practical work, whereas business students were more focused on thinking and reflecting, often with a clear focus on business ideas in a market context. The report suggested that if the creative energies of engineering students could also be geared towards more commercial pursuits, the students should end up better prepared for the realities of entrepreneurial life.

Furthermore, Arnold (2002) suggests that, as engineers graduate and take their first professional engineering position, from the outset they have begun transitioning toward entrepreneurship (regardless of their job description). By augmenting engineering tools with business knowledge and strong communication skills, engineers can deliver optimal returns to their companies and also to themselves. Lumsdaine & Blinks (2003) use the term technopreneurship for the merging of knowledge in technology and entrepreneurship skills. This requires not only technical knowledge but also a thorough understanding of creativity, the innovation process, marketing, finance and strategic thinking.

Bachelor of Science in Engineering Entrepreneurship

In response to numerous recommendations (Hunt, 2011; Fitzsimons & O’Gorman,

2012; 2013; 2014; 2015) for the implementation of entrepreneurship across all levels of education in the third level sector, Dundalk Institute of Technology, under the umbrella of the Accelerating Campus Entrepreneurship (ACE) initiative developed The B.Sc. in Engineering Entrepreneurship.

The ACE Initiative was a joint collaboration between Cork Institute of Technology, Institute of Technology Blanchardstown, Institute of Technology Sligo, National University of Ireland Galway and was led by Dundalk Institute of Technology. The initiative was part-funded by the Higher Education Authority's (HEA) Strategic Innovation Fund (SIF) and co-funded by the Partner Institutions. The overall aim of ACE was, through a collaborative approach, to create entrepreneurial graduates. The initiative sought to achieve its aim by embedding entrepreneurial education in non-business disciplines.

The programme commenced with its first intake of graduates in January 2011. It is a multidisciplinary programme which combines the resources of the School of Engineering with the School of Business and Humanities and The Regional Development Centre (technology transfer centre). The programme is a one-year add-on level 8 programme designed to attract students with a level 7 engineering or technical qualification. The aim of the programme is to produce graduates who are competent in the core engineering/technical skills and have a mind-set capable of recognising and pursuing business opportunities.

The programme integrates entrepreneurial activities (opportunity-seeking actions) and engineering activities (design focused actions) with a view to producing graduates who are competent in core engineering/technical skills and have a mind-set capable of

recognising and pursuing business opportunities. Students commence the programme with an idea which is technical in nature but which has perceived commercial value. Students develop the idea, within the New Venture Development module over the two semesters in terms of its technical and commercial aspects. The outcome is usually the production of a prototype and the completion of a business plan. The New Venture Development Module is at the core of the programme and is supported by the following business and entrepreneurship modules:

- Creativity and Innovation
- Enterprise and Operations
- Marketing and Sales for Enterprise Development
- New Venture Finance
- Legal, Intellectual Property and Commercialisation

Two further discipline specific modules (one in each semester) allow students to build on their existing engineering knowledge and skills. The programme is driven by innovative pedagogy, which includes individual and team-based project-focused learning opportunities for students. The programme structure is designed to simulate the development process experienced by entrepreneurs in a commercial environment. Having completed the programme, students will then have the skill set and information necessary to progress a project from concept to commercialization. Assessments, projects and course work across all modules, support the work of the students in the New Venture Development module. This integrative approach helps to embed entrepreneurship within the programme and build the skills and mind-set to prepare students for both entrepreneurial and intrapreneurial careers.

Methodology

The overall objective of the study was to examine the impact of a designated multi-disciplinary entrepreneurship programme on the development of the students, in particular their attitudes and intentions towards entrepreneurship as a viable career option. An exploratory research approach was used to identify and investigate new insights suggested by the results of the study within the context of public policy and current practice in Ireland in the area of multi-disciplinary entrepreneurship education. An exploratory study is a valuable means of ‘what is happening; to seek new insights; to ask questions and to assess phenomenon in a new light’ (Robinson, 2002, p.59).

The study method was developed in two related but distinct phases. The first phase involved a review of current practices in multi-disciplinary entrepreneurship education and thus, as a literature review, focused on published reports, articles, conference proceedings and government reports in order to develop a body of knowledge, with a specific focus on Ireland. The second phase involved primary research designed to gain a perspective from graduates of a specific multi-disciplinary entrepreneurship education programme designed and delivered at Dundalk Institute of Technology. The intention was to consider entrepreneurship education from demand-side (both the impact and experience of the programme from the students’ perspective).

In 2015 the authors compiled a database of the 36 students who had participated in the programme since its inception in 2011. These students were surveyed electronically in May 2015 using Survey Monkey (www.surveymonkey.com) which collated the results and provided the means for analysing the responses. A survey provides an efficient tool for collecting background, quantifiable data from a specific sample, as well as gathering qualitative information from respondents in the form of experiences and

views (Saunders *et al.*, 2012). The survey response rate was 56% (n= 36). The survey was broad in its application and was designed to collect both quantitative and qualitative information. The survey was structured into the following sections:

1. Sought to establish information regarding graduates' profile to include: nationality, age, gender, background in family business, status on entering the programme and also to identify who or what have been key influences on their motivation towards entrepreneurship as a possible career option.
2. Sought to elicit their perception of their entrepreneurial characteristics and skills.
3. Sought to determine their understanding of entrepreneurship, their motivations towards entrepreneurship as a possible career option and how this has changed since they have participated in the programme and also to determine the barriers which are preventing them from pursuing entrepreneurship as a career option.
4. Sought to elicit their perception of the programme in terms of delivery, content and structure, timetable, teaching methods, links with campus enterprise development centre, links with industry, the level of resources and expertise available for development of their business idea, quality of guest lecturers, extracurricular resources including the student enterprise ambassador, physical facilities and level of support for the ongoing development of their business idea. Students were also asked if the programme has increased their confidence to start their business at some stage in the future. In addition, they were asked to give recommendations for improving the programme.

Despite the comprehensiveness of the methodology employed there are limitations that should be recognised. Firstly, the limited sample size indicates that the results are only a representation of the demand side perspective of students who have participated on similar programmes. Furthermore, it would have been desirable to carry out focus groups in an effort to gain a more in depth insight into the attitudes and opinions of

students. However, this was not feasible due to the geographic dispersion of the students.

Findings

The survey was administered via e-mail to all participants of the programme over the years from 2011/12 - 2014/15 and a total of 20 surveys were completed and analysed.

Profile of Survey Participants

Of the 20 respondents to the survey, 17 were male and 3 were female. The age profile was spread across 4 age categories. 6 were between 20-25 years, 6 were between 26-35 years, 4 were between 36-45 years and 4 were in the range 40-55. The majority, 13 are Irish with the remaining being European (French, Spanish and Finnish on the Erasmus Programme) and 2 are Chinese. Participants were given a list of possible motivations for participation in the programme. These are highlighted in Table 1.

Table 1: Motivations for Participating on the Programme (n=20)

Motivations	Number of Respondents	% of Respondents
Identified a Business Opportunity	6	30
Desire to Obtain a Level 8 Qualification	3	15
Lack of Work Opportunities	0	0
Improve Job Prospects	11	55
Wanted to Maintain Unemployment Benefits	0	0

Perceptions of their Entrepreneurial Instincts

Participants were given a list of entrepreneurial characteristics and asked to rate themselves against each of the characteristics. They were given a rating of Very High (1), High (2), Medium (3), Low (4), Very Low (5) or N/A (6). Table 2 gives the rating average of each characteristic.

Table 2: Entrepreneurial Characteristics and Skills (n=20)

Characteristic/Skill	Rating Average
Appetite for Risk	2.70
Visionary	2.30
Creative	1.95
Self Confident	2.35
Determined	2.00
Over-Controlling	2.95
Decisive	2.25
Egotistical	3.68
Foresee the Future	2.40

The creative skill has a score between 1.95 (between very high to high). All other skills were between 2 and 3 (High to Medium), except for egotistical with a score of 3.68 (between low to very low). Overall the table shows that participants generally have a positive attitude to their perception of their own entrepreneurial skills and characteristics.

The majority of respondents, (15) highlighted that their understanding of entrepreneurship has changed since completing the programme. This is very positive as it reflects the impact of the programme. Participants were asked to comment on their understanding of entrepreneurship. A sample of the comments included:

“I discovered that I needed the knowledge and skill acquired during the programme to do what I am doing today.”

“I now understand that entrepreneurship is not just business but is also social. It is not just for setting up a business but is a skill that can be used in employment as well as all walks of life.”

“The degree has helped me to sell my ideas and become more self-confident. It was the reason I got a job as a design engineer even though I had no experience in the marketplace.”

“It has opened my mind to the broader spectrum of options available for SME businesses - where as I previously may have thought that was reserved for larger companies with significant financial backing.”

Current Position and Motivation Towards Entrepreneurship

Participants were given a list of potential descriptions of their current position since completing the programme. Results are detailed in Table 3. 14 of the respondents are currently employed (10 in their chosen discipline and 4 outside their chosen discipline). It should be noted that to date, none of the students are self-employed. 3 of the respondents indicated they were unemployed at the time of the survey. As the most recent set of graduates were included in the survey, this may explain the reason for being unemployed.

Table 3: Respondents' Current Position since Completing Programme (n=20)

Description of Current Position	Number of Respondents	% of Respondents
Engaged in Education	3	15
Employed in Chosen Discipline	10	50
Employed Outside Chosen Discipline	4	20
Unemployed	3	15
Self-Employed	0	0

Participants were asked whether or not they intend to start a business at some stage in the future. 17 respondents indicated that they do intend to start a business, if not now, at some stage in the future. Participants were given a list of possible motivations for starting a business. Results are detailed in Table 4. Five are motivated by the opportunity to create wealth, three to be their own boss. Five have recognized a potential business opportunity.

Table 4: Motivation for Starting a Business (n=16)

Motivation	Number of Respondents	% of Respondents
To be own Boss	3	18.75
High Need for Achievement	3	18.75
Opportunity to Create Wealth	5	31.25
Frustration with being Employed	0	0
Lack of Opportunities to Progress in Current Employment	0	0
Recognised Potential Business Opportunity	5	31.25
Flexibility of Working Hours	0	0

Participants were also asked to indicate the barriers which may be preventing them from starting their own business. A list of potential barriers as shown in Table 5 was provided to students. Results are also detailed in the same table. It should be noted that only 6 of the 20 students responded to this question.

Table 5: Barriers Preventing students from Developing their own Business (n=6)

Barriers	Number of Respondents	% of Respondents
Access to Finance	3	50
Family Responsibilities/Dependents	1	16.67
Contented in Current Employment	1	16.67
Don't Want to Take the Risk	0	0
Lack of Ambition and Hunger for Success	0	0
Other* (comment box included with question)	1	16.67

One comment highlighted: '...haven't found the golden egg yet!*'

Half of the respondents to this question highlighted that access to finance is a key barrier preventing them from developing their business idea further. The comment: '*...Not having found the golden egg...yet*', could suggest that this respondent may develop a business at some time in the future if the right idea presents itself.

Perception of the Programme

Participants were asked to rate the programme under the following headings as set out in Table 6.

Table 6: Students' Rating of the Programme

Aspects of Programme	Excellent to Good	Good to Fair	Poor to Very Poor
Delivery of Programme	17	2	1
Content and Structure	15	4	1
Teaching Methods	15	5	0
Timetable	14	6	0
Links with Regional Development Centre	10	6	3
Links with Industry	3	11	5
Resources for Idea Development	10	9	1
Guest Lecturers/Entrepreneurs	9	6	4
Student Enterprise Ambassador ¹	2	14	3
Physical Facilities	6	11	3
On-going Guidance for Idea	14	5	1

Participants were asked to indicate how the programme has increased their confidence to start a business in the future. They were given three statements and asked to indicate which best describes them individually in terms of how confident they feel to start a business. Results are displayed in Table 7.

Table 7: Level of Confidence of Students to Start a Business (n=20)

Statement by Student	Number of Respondents	% of Respondents
I feel confident that I will start a Business at some stage in the future	14	70
I now feel very confident that I will start a Business at some stage in the future	5	25
I do not feel confident that I will start a Business at some stage in the future	1	5

14 of the respondents feel confident and 6 feel very confident that they will start a business at some stage in the future. Only one stated that they did not feel confident to start a business at some stage in the future. This is significant as it indicates that despite the barriers perceived in starting a business, they are confident that they will overcome such barriers. This is somewhat out of line with the result of a previous question which showed that 3 respondents indicated that they do not intend to start a business at

¹ The Student Enterprise Ambassador is a role within the Institute to support, enhance and stimulate the development of an enterprise culture within the student body.

some stage in the future. It is interesting to note that two of these same 3 students highlighted the following reasons:

'... Family Responsibilities/dependents.'
'... Haven't found the golden egg.....yet!'

These comments do not exclusively rule out the possibility of a business start up, so it can be concluded that only one out of twenty respondents rules out the possibility of a business start-up at some time in the future. In relation to the three unemployed respondents further analysis showed that two felt confident and one very confident about starting a business in the future.

Suggestions for Improvement of the Programme

Participants were finally asked to give suggestions as to how they feel the programme could be improved. Without listing each response, the following is a synopsis of the responses received:

- The content of the New Venture Finance module should be increased.
- A greater concentration of effort on the New Venture Development Module including the development of the prototype.
- There should be outside interaction with established entrepreneurs to help with the development of students' business ideas.
- The programme should be linked with industry to include a workplace placement.
- Various comments were made in relation to programme/module adjustment.

Overall this feedback was very valuable and will be used to aid in the improvement and development of the programme.

Discussion

The results of the programme indicate significant benefits for the graduates of this programme as well as the industry sector of engineering in terms of increased technology and knowledge transfer. Graduates are more confident of their sense of judgment, better equipped at decision-making and ideas generation and resourceful in pursuing opportunities to commercial value. These skills have obvious application in the setting up of a new business but are equally valuable in all organisations where the need for innovation is becoming more compelling. This reflects a positive impact from the programme.

The results section shows that twenty graduates took part in the survey. The age profile was spread across 4 age categories from 20-25 to 40-55. This reflects socio-economic conditions during this period with many people finding themselves out of work and in pursuit of further qualifications to enable them to retrain in order to compete in the job market.

The majority of respondents indicated that their main motivation for participating on the programme was to improve their career opportunities with only 3 having a desire to obtain a level 8 qualification. None of the participants indicated a lack of work opportunities as their motivator. This is interesting, given that the programme was launched at a time in Ireland of profound economic crisis and a huge surge in unemployment.

The majority of participants (15), highlighted that their understanding of entrepreneurship has changed since completing the programme. 17 respondents indicated that they intend to start a business, if not now, at some stage in the future. Five of these are motivated by the opportunity to create wealth, three to be their own

boss and three have a high need for achievement. Furthermore, 5 have already recognised a potential business opportunity. This indicates that a sizeable cohort have embraced the culture of entrepreneurship. This concurs with Mwasalwida (2010) in his review of entrepreneurship education literature which reveals a process designed to influence attitudes and intentions towards entrepreneurship.

Additionally, this study shows that students are not only developing a business idea for the purpose of earning their qualification, but are interested in the further development of their idea and application of the skillset acquired. The responses reflect the application of the training provided on the programme. Students start the programme with an idea for a new venture (an entrepreneurial opportunity) which they develop in terms of its commercial potential and technical capability.

Half of the respondents highlighted access to finance as a key barrier preventing them from starting their own business. However, the majority indicated they felt confident that they will start a business at some stage in the future. Only one respondent stated that they did not feel confident to start a business at some stage in the future. These findings concur with Henry *et al.* (2003, pp.196-197) who highlighted that students who have completed entrepreneurship programmes yield certain direct benefits, for example; having a broader range of skills and knowledge; possessing greater self-confidence in their entrepreneurial abilities and improving their employability even if they do not start a business.

Participants were asked to rate the programme under a series of headings. The results show that the programme is generally viewed positively. However, it should be noted respondents highlight there are also aspects of the programme which need to be

improved, particularly links with industry. Overall the feedback was very valuable and will be used to aid with the further improvement and development of the programme.

At higher education level, a central purpose of entrepreneurial education should be to develop entrepreneurial capacities and mind-sets. International research highlights the benefits of providing entrepreneurship education to those students outside the business school (Hill *et al.*, 2003; European Commission, 2008). With the recent trends of high unemployment resulting from economic downturn, there is an ideal opportunity to introduce new sources of employment and present self-employment as an attractive and profitable alternative to the conventional career prospects for graduates.

Conclusions

The literature shows strong support for a multi-disciplinary approach to entrepreneurship education. Allen (2010, p.2), states that engineering seems to have a natural symbiosis with entrepreneurship. Entrepreneurs recognise opportunity and gather the resources needed to launch a venture. Similarly, engineers apply mathematics, science and systems integration to conceive, design, build and operate useful objects or processes. Both sets of actions are required for successful entrepreneurship

The report of the European Commission (2008, p.29), states that traditional educational methods do not correlate well with the development of entrepreneurial traits and attributes and that multi-disciplinary collaboration is an essential element of building enterprising abilities. The programme responds very well to the distinct aims of the Department of Jobs Enterprise and Innovation (2014), National Policy Statement on Entrepreneurship in Ireland which are to:

- Build the pipeline of entrepreneurs
- Build entrepreneurial capability
- Build the right conditions for entrepreneurship.

The model used for this multidisciplinary programme is not exclusive to Engineering and could be applied to any Science or Technical educational programme. In order to understand further the long term impacts of such a programme, a longitudinal study will be required to track the progression of the participants and understand the influence and benefits of entrepreneurship education. Additionally, the programme is under review and feedback provided by the respondents will be incorporated into its on-going development.

This paper provides an example of an innovative response to the challenges presented by an ever changing global economy. The results clearly indicate that the programme is successful in making students more employable, giving them skills and knowledge required across all disciplines and in the long term generating an entrepreneurial culture which is a pre-requisite for sustainable economic growth.

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