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Enterprise skills and training needs of postgraduate research students

Kelly Smith, Head of Enterprise, the University of Huddersfield
Queensgate, Huddersfield, HD1 3DH
44(0)1484 473277; k.smith@hud.ac.uk

Dina Williams, Senior Lecturer, the University of Huddersfield

Naveed Yasin, Research Assistant, the University of Huddersfield

Ian Pitchford, Head of Strategy, Policy & Engagement, the University of Huddersfield

Abstract

Purpose

This paper presents a survey of postgraduate research students (PGRs) studying at the University of Huddersfield, concentrating on entrepreneurial attributes and the importance of enterprise-related skills future career intentions.

Design/methodology/approach

Electronic survey questions asked respondents to rate their confidence in a series of enterprise-related skills, and each skill's importance in their career development. Identification with attributes relating to independence, risk taking, self-efficacy, tolerance of ambiguity, and innovativeness were explored. Further questions probed the importance of enterprise skills development, research impact, and career aspirations including business start-up potential.

Findings

Respondents identified with entrepreneurial attributes and were positive towards enterprise skills development. The majority felt that their research could have commercial impact, and over a third reported that starting a business appealed to them. Comparisons of importance and confidence ratings identified skills areas a) where confidence was relatively low and needed to be improved, b) where there is a large gap between confidence and importance and c) where a skill was rated as having lower importance than is optimal from an institutional perspective. Interestingly, different groups of students considered 'self-employment' compared with 'business start-up' as a career option.

Research limitations/implications

These single-institution results suggest that PGRs are more entrepreneurial than might be expected. Is the Higher Education (HE) sector underestimating the entrepreneurial potential of our PGR population, their appetite for engaging in enterprise, and their enterprise and commercialisation training needs?

Originality/Value

The results have relevance for the HE community in terms of understanding PGR entrepreneurial attributes, and training needs for enterprise and commercialisation of research output.

Keywords Enterprise Skills, Entrepreneurial Attributes, Postgraduate Researchers, Higher Education

Paper type Research Paper

Enterprise skills and training needs of postgraduate research students

Introduction

Policy drives over more than a decade stress the need for researchers to be prepared for employment in both industry and academia; to be more aware of the needs of business as a research partner and end user; to be able to recognise and act on opportunities to commercialise research output; and to be aware of business start-up as a potential career option (e.g. Wilson 2012, Roberts 2002). Postgraduate skills have been described as one of the most powerful levers for improving productivity, critical to a high skills, high performance economy (Leith, 2006), major drivers of innovation and growth (Smith et al. 2010), and a vital part of our innovation infrastructure (Higher Education Commission, 2012).

Despite the repeated recognition that Universities and researchers - including postgraduate research students - (PGRs) have a vital role in supporting and encouraging a growing economy, there is currently little published information on the state of enterprise education provision and the needs of postgraduate research students in

relation to enterprise and entrepreneurship education, and few accessible examples of good practice (Williams et al., 2013; Lean, 2012; Phillips, 2010; Zalevski and Swiszczowski, 2009).

This paper will explore and summarise recent literature relating to enterprise and commercialisation training for PGRs and career development needs. It will describe the development and analysis of a training needs survey developed to inform a programme of enterprise and commercialisation skills training initiatives at the University of Huddersfield and explore the relevance of the survey's findings to the wider university sector.

Enterprise education and commercialisation training for PGRs

As definitions of enterprise and entrepreneurship education vary, this paper will use those developed by the UK's Quality Assurance Agency (QAA, 2012, p 8) where enterprise education aims to produce graduates with the mindset and skills to come up with original ideas in response to identified needs and shortfalls, and the ability to act on them, and entrepreneurship education focuses on the development and application of an enterprising mindset and skills in the specific contexts of setting up a new venture, developing and growing an existing business, or designing an entrepreneurial organisation.

Enterprise education is a commonly identified theme within policy calls and initiatives concerned with fostering entrepreneurial universities and enterprising graduates (BERR, 2008; BIS, 2010a, 2010b, 2011; UNCTAD 2012) with the European Commission's Entrepreneurship 2020 Action Plan stating that "investing in entrepreneurship education is one of the highest return investments Europe can make" (2013; p5). Entrepreneurship was recognised by the EU as a key competence for lifelong learning (European Commission, 2006) and an action in a recent Rethinking Education Commission Communication (European Commission, 2012).

The Higher Education Commission (2012) states that postgraduate research and study provides an opportunity for graduates to develop expertise and thinking skills that will be in high demand in parts of the knowledge economy. They point out that the R&D departments of the UK's largest companies are comprised of PhDs translating and applying new thinking to business and scientific problems and that many of the UK's most innovative start-ups are the initiative of recent postgraduate students.

A recent in-depth study commissioned by the Department for Business, Innovation & Skills (BIS) explored the impact of enterprise education in HE and Further Education (FE), looking at 77 academic papers and policy documents from around the world (BIS 2013). Although the focus of the research was on 19-24 year olds – thus excluding PGR students who normally start their studies at 24 – it found that participation leads to students acquiring relevant business related knowledge, skills and competences for enterprise and entrepreneurship, that they are more likely to change attitudes (e.g. risk taking), and intentions (e.g. such as around being self-employed or being entrepreneurial, than non-participants). There is also a suggestion that enterprise education may positively impact on Gross Value Added (GVA) economy measures.

Enterprise education can thus be seen to be of direct relevance to an academic career which is based around the creation of new knowledge through innovative practice, where bidding for and managing external funding is a necessary element, where there is an increasing drive to make impact of research output explicit and related research to end-user need, and where exploitation of research output is increasing being seen as a possible additional funding stream to supplement research and teaching income. Linked to this, there is an increased need for researchers to develop management and commercial awareness and for institutions to provide training programmes for the new generation of young researchers (Nerad and Heggelund, 2008; Thune, 2010). In terms of entrepreneurship education, the European Commission calls for the endorsement of successful mechanisms of university-driven business creation, and university-business ecosystems supporting such creations (European Commission, 2013).

In their 2013 report - Growing Value: Business–University collaboration for the 21st century – the Council for Industry and HE (CIHE) and the United Kingdom Innovation Research Centre (UK-IRC) call for the promotion of entrepreneurship and entrepreneurial corporate management in universities in order to enhance risk-taking and innovation in business. They propose that universities encourage students to learn from participation in start-ups, and engage postgraduates in business-inspired problem solving and research activities. The report further suggests that there should be more structured programmes of knowledge exchange between university researchers and PhD students, linking with R&D departments in business to increase the flow of ideas and the understanding of how to commercialise them (CIHE/UK-IRC, 2013). However both the CIHE/UK-IRC (2013) and the House of Commons Science and Technology Committee (2012) express concerns about the ability of UK universities to interact with the commercialisation of research.

In his seminal review of University-Business collaboration, Wilson (2012) explicitly recognises the role of PRG students and early career researchers and makes the following recommendation:

All full-time PhD students should have an opportunity to experience at least one 8 to 12 week internship during their period of study and should be encouraged to attend a short intensive enterprise skills programme alongside research students from other departments of the university. Universities should increase support for postgraduate students seeking to set up their own businesses.

Wilson (2012) Recommendation 21, paragraph 5.9.3 (p 5)

Although there was no specific comment in relation to this recommendation, the Government's response to the Wilson review recognised that entrepreneurial skills are essential to the creation and application of new ideas, and adapting to technological change, transforming ideas into new products, processes and organisational structures. Entrepreneurial skills, fostered through entrepreneurship education, are vital in achieving a more innovative and competitive economy (BIS, 2012).

PGR Career Development

House of Commons Science and Technology Committee (2012) states that "the value of universities also lies in the people they produce: not only the academics who will engage with the cutting edge research that is so vital to innovation but also those who will provide the technical backbone to the knowledge economy". European Commission (2012) also states that education needs to drive up both standards and levels of achievement and encourage the transversal skills needed to ensure young people are able to be entrepreneurial and adapt to the increasingly inevitable changes in the labour market during their career. It is therefore important that enterprise and entrepreneurship is considered as integral to PGR career development.

Disappointingly, a relatively recent view of Research Councils was that "the PhD provides neither a rigorous enough methodology training for those who go into academia, nor an appropriate initial and continuing professional development for those who go outside" (Park, 2007, p. 30). As a response to the Robert's review (Roberts, 2002) UK universities began embedding a range of skills within doctoral training programmes, culminating in the development of the Researcher Development Framework (RDF) (VITAE, 2011a). Endorsed and supported by Research Councils UK and other HE organisations, the RDF describes the knowledge, behaviours and attributes required of researchers, encourages those seeking a career in research to aspire to excellence through achieving higher levels of development, and assists in planning, promoting and supporting their personal, professional and career development. Importantly here, VITAE have produced a serious of 'lens' on the RDF looking at thematic areas of development with one putting an 'enterprise lens' on the RDF (VITAE, 2011b). VITAE also produced a booklet in 2014 titled 'The Enterprising Researcher' where enterprise is defined as 'a set of capabilities and attitudes that can enable a culture of innovation, creativity, risk taking and opportunism that underpins employability, enables entrepreneurship and intrapreneurship, and facilitates knowledge transfer' (Goodman et al., 2014; p3).

Graduates at all levels are expecting and expected to be trained for what is increasingly seen to be a dynamic market for 'knowledge workers'. However, the career trajectories and expectations of PhD holders are still relatively limited, with a career in HE reported as the preferred career choice of 49% of those with a firm idea (Mellor-Broune et al., 2012, Hodges et al., 2011). In the UK the employment rate among PhD graduates remains stable at 80%, with around 50% employed in the broadly defined education sector. Research is a primary occupation for PhD graduates with 22% working as postdoctoral researchers in HE institutions, 14% employed in research roles outside academia. Teaching roles accounted for 22% of PhD occupation with the large majority in HE (Haynes and Metcalfe, 2007). The Wilson Review (Wilson, 2012) draws upon the result of a VITAE survey emphasising only 23% of PhD graduates were employed as academic staff 3.5 years after graduation. It stated that "there is a distinct disconnect between the aspirations of research students and the reality of their future career pathways" (Wilson, 2012, p. 62).

PGR Enterprise at the University of Huddersfield

The University of Huddersfield has a strong reputation for developing enterprising and employable graduates and for being entrepreneurial in its outlook; it was awarded the National Centre for Entrepreneurship in Education sponsored Times Higher Education Entrepreneurial University of the Year title for 2012.

Enterprise and entrepreneurship learning opportunities are provided across campus at all levels including a BA in Enterprise Development where students undertake and reflect on new venture creation as part of their assessed learning, full enterprise-related modules, and modules where enterprise and entrepreneurship-related learning is embedded in the subject-specific curriculum. An Enterprise Placement Year is offered to undergraduate students wishing to explore self-employment through a sandwich placement instead of working for others. Two innovative postgraduate research programmes are also offered – a Masters of Enterprise and

an Enterprise Doctorate – where the research undertaken is required to underpin a new business, social enterprise, or service innovation.

The Enterprise Team, based in the Duke of York Young Entrepreneur Centre in the University's 3M Buckley Innovation Centre (3MBIC), offers an extra-curricular series of enterprise skills workshops, and provides one-to-one business start-up support. The University is also lead partner on the European Regional Development Fund (ERDF) funded Yorkshire and Humber-wide Graduate Entrepreneurship Project, supporting student and graduate business start-up out of the region's HE institutions.

In 2011, the University recognised the need to enhance enterprise and commercialisation skills development of its growing PGR population with the aim to increase the number of PGR-led knowledge-based graduate spin-outs, to enable PGRs to better respond to end-user research needs, and to increase the exploitation of PG research output and specialist knowledge. The University successfully applied for an Enterprise Educators UK (EEUK) Education and Research Grant in order to explore best practice in PGR enterprise and commercialisation skills training (Williams et al., 2013), and to develop a survey in order to conduct a training needs analysis.

The paper describes and presents the findings of the training needs analysis and enterprise attitudes survey distributed to all PGR students at the University of Huddersfield. Although it is University of Huddersfield specific, the findings have relevance across the UK and potentially beyond. Key findings of wider relevance are highlighted along with suggestions for future research.

Methods

An online survey was distributed to all registered postgraduate research students at the University of Huddersfield at both Masters and Doctoral level. The survey was presented and data collected using the Bristol Online Survey platform in July/August 2012. A £50 voucher draw prize was offered as an incentive to respond. Exactly 100 responses were returned giving a response ratio of 11.1%.

The survey was split into 5 sections:

Section A: Demographics

This section included questions on age, gender, fees status (Home/EU/Non-EU), ethnicity, programme of study (Masters of Arts or Science by Research, Doctor of Philosophy, Master of Doctor or Enterprise, or Professional Doctorate), mode of study (part time, full time, or writing up), year of study, academic school (University of Huddersfield specific), research discipline (Allied Health and Biological Studies; Engineering and Physical Studies; Social Sciences; Arts and Humanities).

Section B: Confidence in Skills

Respondents were asked to rate their confidence 'at this point in time' on a range of 24 different skill on a five-point likert scale (Not at all confident, Not confident, Neutral, Confident, Highly confident). Additional options for 'Don't know' and 'Not applicable' were also provided. The 24 skills listed were primarily derived from VITAE's 'Enterprise Lens on the Researchers Development Framework' (VITAE, 2011b) with some additions made to explore business planning and institutional knowledge transfer policy. A full list of items can be found in Table 1 in the results section. There are some parallels here with a study by Lean (2012) conducted at the University of Plymouth looking at ratings of ability to perform on a series of 27 items.

Section C: Importance of Skills for the Future

Respondents were asked to rate how important the 24 skills items presented in Section B are towards their personal/professional development and their future career. Skills were rated on a five-point likert scale (Not at all important, Not important, Neutral, Important, Highly important). Additional options for 'Don't know' and 'Not applicable' were again provided.

Section D: Entrepreneurial Attributes

18 items adapted from Wagener et al. (2010) were used to assess respondents' entrepreneurial attributes. Wagener et al. brought together 22 items in 7 categories to assess the differences between entrepreneur and business owners in the hospitality industry. The seven categories were: 1. Independence; 2. Risk-taking propensity; 3. Tolerance of ambiguity; 4. Self-efficacy, 5. Innovation and creativity, 6. Market orientation; and 7. Leadership qualities.

Items from categories 1-5 above were used in this study with adaptations to the language used to aid comprehension for general respondents rather than those exclusively in business. Sections 6 and 7 were not used as references were made to customers and employees that were not appropriate here. An additional 4 items were included based on suggestions from literature (e.g. Frugier et al., 2003; and Lumpkin and Dess,

1996) and the authors here. The additional items were: 'I take responsibility for my own actions', 'It is important for me to excel at what I do', and 'I deliberately seek out new opportunities'.

Respondents were asked to rate how closely each of the item statements described them on a five point likert scale (Not at all me; Not really me; Neutral; Somewhat me; Totally me). No options for 'Don't know' or 'Not applicable' were provided here. A full list of items used in Section D can be found in Table 2 in the results section.

Section E: Career Aspirations, Research Impact, and Enterprise Skills Training

This section contained questions on a variety of topics including careers aspirations on completion of their research study, whether they had a business plan or business idea, and whether starting a business appealed to them. Respondents were also asked about potential for commercial and other research impact, and experience of enterprise skills training.

Results and Analysis

Demographics

The numbers of respondents in each category were generally representative of the population at the University of Huddersfield with 56 males and 44 females and with more students in the older age groups (10 were 21-24, 25 were 25-30, 19 were 31-35; and 46 were over 35). 56 respondents were classed as Home/EU and 44 as Non-EU. The majority gave their ethnicity as White (40 were White British and 15 White Other); other stated ethnicities were Middle East and Other Asian (17), Black African (8), Chinese (7), and Other (14) with 1 further respondent preferring not to say.

Most respondents were studying for a PhD (87) with 10 studying for a Masters by Research, and 3 a Professional Doctorate. 69 were studying full time and 25 part time, with 6 in writing-up phase. 31 respondents were in their first year of study, 30 in their second, and 23 in their third year; smaller numbers of 9 and 5 were in their fourth and fifth years of study respectively.

PGR students at the University of Huddersfield are registered in one of seven academic Schools. The largest group of respondents to the survey were based in Computing and Engineering (25), followed by Human and Health Sciences (19), Music, Humanities and Media (18), Business and Law (13), Applied Sciences (12), Education and Professional Development (8), and Art, Design and Architecture (5), broadly mirroring the relative numbers of registered PGR students at the University.

In order to facilitate future comparisons with other HE institutions, students were asked to self-define into one of four research areas: Engineering and Physical Sciences (34 respondents), Social Sciences (35), Arts and Humanities (23), and Allied Health and Biological Sciences (8).

Confidence In and Importance Of Enterprise Skills

Table 1 and Figure 1 give mean confidence (Section B) and importance (Section C) ratings for each of the 24 enterprise-related skill items. All items were deemed to be significantly important for PGR students' personal/professional development and future career. Respondents were significantly less positive about their confidence in each skill compared with its importance, however, they were significantly confident in 19 out of the 24 items. Four items were not significantly different from neutral ('Understanding contracts and legal issues'; 'Selling and negotiation skills'; 'Writing a business plan'; and 'Applying for funding, sponsorships and generating income'). Respondents were significantly not confident in 'Awareness of University policy on technology transfer and commercialisation'. The items with the lowest confidence ratings are highlighted on Figure 1.

Figure 1 shows that there is a positive relationship between confidence and importance scores. A Pearson's Correlation test confirms this relationship to be highly statistically significant [$r(23)=0.76$; $p<0.01$]. Table 1 also shows that the items with the lowest confidence and importance ratings also have the highest number of 'Don't Know' and 'Not Applicable' responses.

Table 1: Confidence and Importance Items

Items scored from -2 to 2 where -2 is Not at All Confident/Important and 2 is Highly Confident/Important and listed in order of highest to lowest mean Confidence. Numbers of Don't know (DK) and Not Applicable (N/A) responses given in brackets

Item	Confidence Mean (DK, N/A)	Importance Mean (DK, N/A)	Difference in Mean Ratings
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Collaborating in a team	0.96	(3, 0)	**	1.41	(1, 0)	**	0.45
Seeking information and applying it creatively to a situation or problem	0.89	(2, 0)	**	1.43	(0, 0)	**	0.54
Responding to changes and opportunities	0.88	(3, 0)	**	1.46	(3, 0)	**	0.58
Analysing, synthesising, thinking critically and evaluating	0.87	(2, 0)	**	1.58	(3, 0)	**	0.71
Prioritising and managing your activities	0.82	(1, 0)	**	1.49	(0, 0)	**	0.67
Being innovative	0.81	(4, 0)	**	1.52	(4, 0)	**	0.73
Delivering presentations	0.81	(1, 0)	**	1.54	(0, 0)	**	0.71
Self motivation	0.80	(3, 0)	**	1.54	(1, 0)	**	0.74
Planning, organising and delivering projects	0.76	(2, 0)	**	1.61	(1, 0)	**	0.85
Understanding ethics, integrity, and professional standards	0.75	(2, 1)	**	1.24	(0, 1)	**	0.49
Selecting activities useful for your professional and career development	0.72	(4, 0)	**	1.36	(2, 1)	**	0.64
Self-reflection	0.71	(2, 0)	**	1.44	(1, 0)	**	0.73
Leading and managing a team	0.70	(4, 3)	**	1.35	(3, 0)	**	0.65
Managing risks	0.62	(6, 2)	**	1.24	(5, 1)	**	0.62
Writing project proposals	0.46	(1, 1)	**	1.60	(3, 1)	**	1.14
Writing job applications	0.44	(3, 1)	**	1.23	(1, 1)	**	0.79
Understanding and managing financial resources	0.42	(3, 5)	**	1.17	(3, 2)	**	0.75
Effectively networking	0.37	(1, 2)	*	1.41	(2, 0)	**	1.04
Understanding intellectual property rights, copyright and patents	0.26	(2, 3)	*	1.06	(1, 1)	**	0.80
Understanding contracts and legal issues	0.17	(5, 2)		1.01	(1, 2)	**	0.84
Selling and negotiation skills	0.12	(6, 4)		0.89	(5, 4)	**	0.77
Writing a business plan	-0.13	(6, 8)		0.69	(4, 7)	**	0.82
Applying for funding, sponsorships and generating income	-0.16	(4, 9)		1.46	(2, 4)	**	1.62
Awareness of University policy on technology transfer and commercialisation	-0.33	(8, 4)	*	0.60	(10, 3)	**	0.93

* One-sample Wilcoxon Signed Ranks test against a neutral 0 score significant at $p < 0.05$

** One-sample Wilcoxon Signed Ranks test against a neutral 0 score significant at $p < 0.01$

Related-samples Wilcoxon Signed Ranks tests between Confidence and Important scores were significant at $p < 0.01$ for all items

The results show parallels with those of Lean (2012) who also found a positive correlation between performance (which, it could be argued, is similar to the confidence here) and importance. Importance scores were also higher than performance. The lowest performance ratings in the Lean study, included 'Ability to manage people' and 'Ability to manage finance/people', which could be seen to be analogous to the higher scoring confidence ratings for 'Leading and managing a team' and 'Understanding and managing financial resources' here. Lean's 'Ability to undertake consultancy' and 'Ability to commercialise an idea' are possibly comparable to 'Awareness of University policy on technology transfer and commercialisation' which also elicited a low confidence score here.

Although confidence can hopefully be improved with enterprise skills training for all items three types of specific intervention have been identified from the data provided in Table 1 and Figure 1: a) where confidence is relatively low and needs to be improved, b) where confidence may not be particularly low, but where there is a large gap between confidence and importance c) where a skill was rated as having lower importance than is optimal from an institutional perspective.

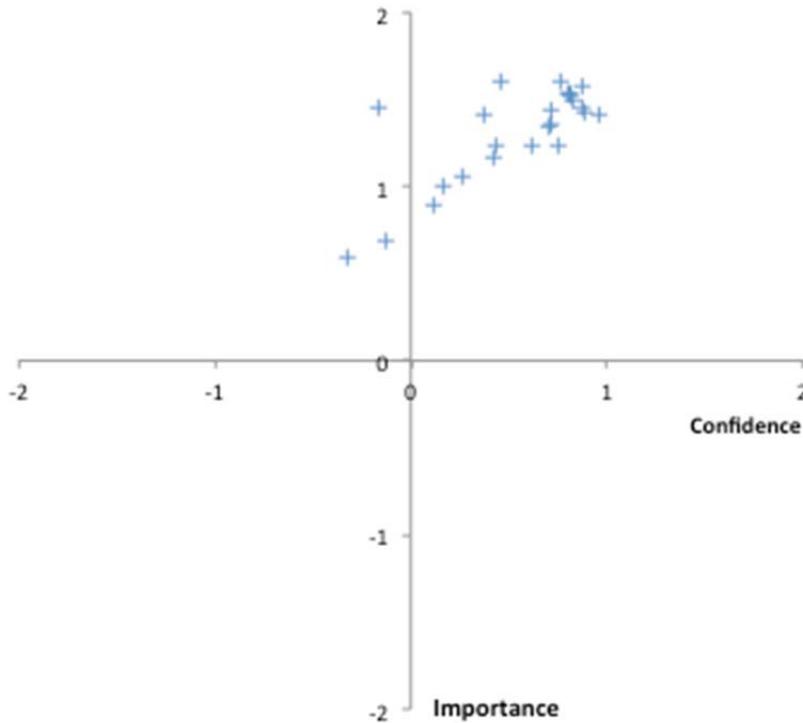


Figure 1: Relationship Between Mean Confidence and Importance Ratings

Entrepreneurial Attributes

Section D explores the entrepreneurial attributes of PGR students. Mean scores for responses to each statement are given in Table 2. The mean scores for all items were significantly different from a neutral score, suggesting that PGR students are indeed entrepreneurial in attitude. This is not necessarily surprising given the nature of postgraduate research which should be independent, innovative and result in the generation of new knowledge. There is perhaps an anecdotal view of academics working in HE of being risk adverse and slow to embrace change. Although the two items identified by Wagener et al. (2010) as being related to tolerance of ambiguity and change score relatively low, they are still significantly above neutral here; items related to risk are spread throughout the mean score continuum.

Total entrepreneurial scores were calculated and items tested for reliability. Scores could range from a minimum total of -36 to a maximum of +36 with +36 representing the most entrepreneurial total score possible. The 18-item scale was shown to be reliable with a Cronbach's Alpha score of 0.89.

A series of statistics tests were conducted to explore differences in total entrepreneurial attitude score for each demographic measure. A one-way independent-samples ANOVA to test for differences by Ethnicity (White British, White Other, Middle East and Other Asian, Chinese, Black African, and Other) was shown to be significant. A significant difference was found [$F(5, 92) = 2.36$; $p < 0.05$] with the Black African group showing the most entrepreneurial mean attribute scores and the Chinese group the lowest (means: White British = 18.72; White Other = 20.07; Middle East and Other Asian = 17.35; Black African = 26.75; Chinese = 14.57; Other = 15.83). No significant differences were found for any other demographic category.

Questions related to self-employment and business start-up were presented in Section E and used to test for differences in entrepreneurial attitude. One question asked respondents to consider various career options including self-employment and business start-up (see below for further details on this question). There was a significant difference between the total entrepreneurial attribute scores of the 21 respondents considering self-employment or business start-up as a potential career option compared with the 79 who were not [$t(42.66) = 1.76$; $p < 0.05$], the self-employment/business start-up group having the higher (more entrepreneurial) total scores (means = 21.14 considering and 17.94 not considering).

Table 2: Entrepreneurial Attributes

Items scored from -2 to 2 where -2 is Not At All Me and 2 is Totally Me. Items are sorted by mean rating with those considered most like the respondents at the top of the list.

Item	Mean	Scale Category
I take responsibility for my own decisions	1.46	Add
It is important for me to excel at what I do	1.32	Add
I am open to new and challenging ideas	1.28	Creat
I am prepared to invest much of my time and resources to make a change	1.13	Risk
If I get a chance, I will take it	1.11	Risk
I am confident that I could deal with unexpected events	1.11	Eff
Even under pressure, I make my own decisions	1.08	Ind
I regularly come up with new ideas	1.07	Creat
No matter what comes my way, I can usually handle it	1.06	Eff
I prefer to make decisions myself	1.03	Ind
When I am confronted with a problem, I can usually find several solutions	1.03	Eff
I trust in my own judgment	0.96	Ind
I deliberately seek out new opportunities	0.96	Add
I consider creativity as one of my stronger points	0.95	Creat
I believe I am in control of my own future	0.95	Add
It is not unusual for me to change the way I am working if the situation requires change	0.77	Amb
I regularly take calculated risks	0.69	Risk
I see uncertainty as a challenge rather than a threat	0.65	Amb

One-sample Wilcoxon Signed Ranks tests against a neutral 0 score significant at $p < 0.01$ for all items
 Scale Categories: Ind = Independence; Risk = Risk-taking propensity; Amb = Tolerance of ambiguity; Eff = Self-efficacy; Creat = Innovation and creativity; Add = Additional items

There was also a significant difference in total entrepreneurial attribute scores between those with a business idea against those without [$t(64.33)=3.19$; $p < 0.01$; means = 22.47 with and 16.62 without], but not between those with and without a business plan [$t(16.93)=1.46$; $p=ns$; means = 22.21 with and 18.03 without]. Although the mean total scores were higher for those who stated that starting a business did appeal to them compared with those for whom it might appeal and those for whom it did not appeal, the difference did not reach significance [$F(2,97)=0.78$; $p=ns$; means = 20.73 Yes, 17.97 Maybe; 17.54 No]. There was also no significant difference for those with family experience of entrepreneurship against those without [$t(74.53)=0.29$; $p=ns$; means = 18.95 and 18.39 respectively].

Career Intention

Respondents were given a variety of potential careers options and asked to tick all that applied to their current intentions. The number of positive responses to each option is given in Table 3. Perhaps not unexpectedly, the most popular career option was to stay in academia followed by other research-focused options. Undertaking research or working in the public sector was more popular than their private-sector alternatives despite the current loss of public sector graduate jobs. As Rae et al. (2010) suggest, the reduction in the public sector will mean that graduates will require higher levels of skills in business and enterprise to compete in the changing job market, or to create self-employment opportunities and employment for others (Rae et al., 2010).

Two career options related to new venture creation were included here - 'Self-employment' and 'Start a business' – to reflect the authors' informal observations that there is a difference in students' use of language and willingness to identify with specific terms. Table 3 shows that 16 respondents stated they were considering self-employment and 9 starting a business. This result is higher than was expected by the authors but, as will be seen below, may be underestimating the entrepreneurial appetite of PGR students.

Looking at the data more closely, 21 individuals expressed an interest in self-employment or business start-up with 12 interested in self-employment only, 5 starting a business only, and 4 considering both options. This result is of particular interest to researchers into entrepreneurial intentions and impact of enterprise and entrepreneurship education where the measures used often focus on business start-up rather than or in addition to self-employment. It also suggests a need to be sensitive to the use of such terms in marketing material and learning content as use of one term over another could influence willingness to engage.

Table 3: Career Intention

Career Intention	N
Academia (Higher Education)	62
Research in the public sector	37
Independent research outside academia	36
Research in the private sector	24
Working in the public sector	22
Self-employment	16
Start a business	9
Working in the private sector	9
Teaching below Higher Education Level	7
Returning to funded employer	2
Working outside the UK	2

Respondents were asked whether or not they currently had one or more of the following career planning or business tools: CV, Personal Statement, Portfolio, Business Plan or Business Idea. The numbers of respondents for each item is given in Table 4. The majority of respondents had a current CV but, of particular interest here, 14 reported having a business plan and 34 reported having a business idea – the latter number being 13 more than reported an interest in self-employment or business start-up in Table 3. Table 5 looks in more detail at this potentially anomalous result, also bringing in further questions about the appeal of business start-up and family experience of running a business.

Table 4: Career planning

Career Planning/Business Tool	N
Current CV	83
Personal Statement	47
Portfolio	27
Business Plan	14
Business Idea	34

Table 5: Responses to business-related questions by self-employment and/or business start-up career choice

Statement	Response	Self-employment	Business start-up	Both	Neither	Total
Have Business Plan	Yes	1	2	1	10	14
	No	11	3	3	69	86
Have Business Idea	Yes	6	4	2	22	34
	No	6	1	2	57	66
Does having your own business appeal?	Yes	7	2	3	26	38
	Maybe	1	1	0	27	29
	No	4	2	1	26	33
Family member runs a business	Yes	4	1	2	32	39
	No	8	4	2	47	61

Of the 21 respondents currently considering a career in self-employment or business start-up, only 4 have a business plan; 17 do not. 12 report having a business idea but 9 do not. The University of Huddersfield's Enterprise Team provide a suite of business start-up activity to help those with a idea plan their business development, however, we are not currently able to help those who wish to pursue self-employment or business start-up but do not have a business idea to take forward. Tasks within enterprising researcher and commercialisation training sessions (see below) require attendees to explore how their research can be used to improve their environment and have impact; these may help identify potential business ideas, but more may need to be done and this result requires more in-depth exploration.

Also interestingly, the thought of having their own business did not appeal to 7 of those who reported considering self-employment or business start-up as a career option. This again requires further exploration: are these respondents concerned about more traditional career options being closed and feel they have to consider self-employment/business start-up even if they don't want to? Are they feeling pressurised by others?

Perhaps even more surprisingly, 10 of those with a business plan and 22 of those with a business idea did not report that they are currently considering a career in self-employment or business start-up. This again requires further research to explore why this group did not report this as a potential career option. Do they consider their plan or idea to be separate from their research study and career aspirations? Could they be encouraged to move their entrepreneurial skills and attributes into their research area? Are they looking to take their business idea or plan forward whilst being employed in academia? Are PGR students more entrepreneurial than would be suggested by looking at entrepreneurial intent through self-employment/business start-up metrics alone?

Previous research suggests that students and graduates with family experience of running a business are more likely to choose an entrepreneurial career (Nabi, 2006; Rae and Woodier, 2006). This does not appear to be the case here with no differences in the rate of self-employment/business start-up between those with and without family experience.

Research Impact

When asked whether their research had commercial impact potential, 20 respondents said yes, 15 said no, and 65 said they didn't know. This bodes well for commercialisation of research, particularly if enterprise skills or commercialisation training can help more identify where their research could lead to income generating activity through employment, spin-out, or non-university business start-up.

Table 6 explores impact potential in more detail. Here respondents were asked to identify all types of impact relevant to their research. Perhaps not surprisingly, the most common response was creation of new knowledge followed by informing the direction of future research – the responses most associated with a traditional academic research career. However, the vast majority of respondents recognised that their research could have one or more forms of impact on the end-user; only 3 respondents stated that their research would have no impact.

Table 6: Impact potential

Type of Impact	N
Creation of new knowledge	64
Informing direction of future research	55
Impact on quality of life	46
Cultural impact	41
Public policy and services impact	35
Social impact	34
Economic impact	33
Impact on health	16
Environmental impact	12
No impact	3

Development of Enterprise Skills

54 respondents stated that they would like to see the inclusion of optional enterprise and entrepreneurship training in their postgraduate research degree programmes with 44 saying 'maybe'. Only 2 respondents said they would not like to see optional enterprise skills training provided as part of their degree programme. Of course, wishing to see inclusion of optional skills development opportunities will not necessarily convert to actual take-up, but taken with other results reported here suggests a positive view of enterprise and its relevance to postgraduate research study. Figure 2 shows PGR students' positive views of enterprise most compellingly. Here, respondents were asked how important the development of enterprise skills was to them. The responses were overwhelmingly positive with 63 stating that enterprise skills development was highly important or important; only 3 respondents stated it was not important or not at all important.

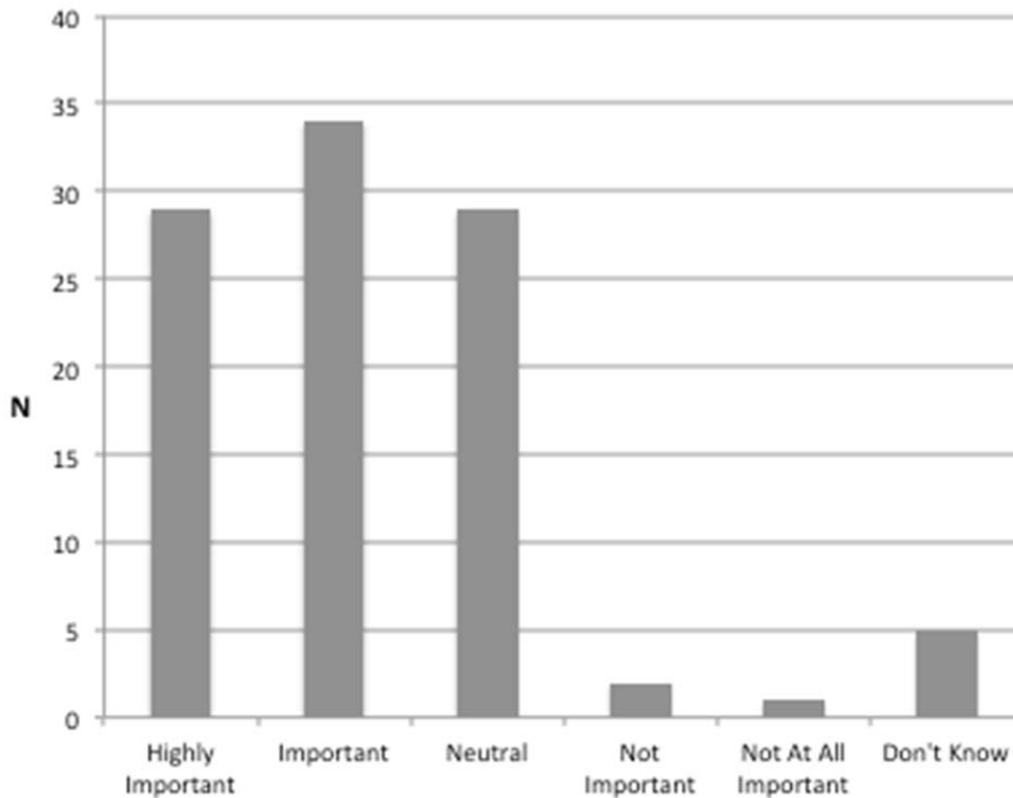


Figure 2: Importance of Development of Enterprise Skills

Despite the recognition of enterprise as important to PGR skills development, we know that the enterprise skills/research commercialisation courses and business start-up opportunities offered at the University of Huddersfield are not well attended by PGR students. Further questions in the survey were included to explore why this might be the case. Table 7 confirms that take up of relevant optional courses (Enterprising Research and Intellectual Property) is indeed low and that few PGR students engage with business start-up workshops and support offered by the University's Enterprise Team (called the Business Mine at the time of the survey). The data shows that a large number of respondents were not aware that courses or opportunities were available to them. The University can now explore how to improve visibility through improved direct marketing, working with supervisors, and through our recently announced new Graduate School. More positively, the vast majority of respondents would consider engaging with the courses and opportunities on offer, but the question of how to convert consideration into actual attendance remains. Further research is also required into if and why there is a mismatch between the ratings of importance of skills development as shown in Figure 2, and low take-up/rejection of opportunities shown in Table 7.

Table 7: Awareness of and Attendance at Enterprise Skills Training Opportunities

Initiative	Aware and considering	Aware and have attended	Aware but not interested	Not aware and not interested	Not aware but would consider
Enterprising Researcher	30	7	11	4	48
Intellectual Property Course	19	2	10	14	55
Business Mine Events Programme	21	2	13	24	40
Business Mine Start-up Support	15	1	16	22	46

A final question asked respondents to rate their satisfaction with enterprise skills training they have undertaken. Of the 9 who had attended one or more of the University of Huddersfield initiatives listed above, 3 were highly satisfied and 6 were satisfied. 21 respondents provided satisfaction ratings for other enterprise training initiatives. 1 respondent was highly satisfied, 10 satisfied, 9 neutral and 1 highly dissatisfied. Although no details of the other initiatives were provided and we have no information on their level, content, or location of delivery, the responses suggest that the enterprise skills training provided at the University of Huddersfield compares favourably in terms of satisfaction.

Conclusions

The results of the survey presented here provides evidence that postgraduate research students at the University of Huddersfield are far more entrepreneurial and willing to consider self-employment/business start-up and/or commercialisation of research output than might be expected - from literature that suggests that entrepreneurial intent increases with education level until it reaches HE when it drops, and from assumptions in some areas that academics (with PGRs being academics in training) are risk adverse, slow to embrace change, and resistant to recognise the impact potential of their research work. Although this is useful from a local University perspective, it raises a wider issue: is the Higher Education sector underestimating the entrepreneurial potential of our PGR population, their appetite for engaging in enterprise whilst at University, and their enterprise and commercialisation training needs?

The entrepreneurial nature of PGRs at the University of Huddersfield is demonstrated here in various ways. First, respondents are confident in the majority of skills related to enterprise as identified by VITAE in their enterprise lens on the research development framework (VITAE, 2011b), and recognise all the same skills as important to their personal/professional development and future career.

Secondly, respondents rated themselves significantly above neutral on all items used to explore entrepreneurial attitudes and attributes such as independence, risk-taking propensity; tolerance of ambiguity, self-efficacy, and Innovation and creativity. The majority of the items used here have been adapted from those used by others (c.f. Wagener et al., 2010) to explore groups of entrepreneurs and business owners, and the high scores shown on many of the items by respondents in this study suggest that PGRs may be comparable, although it is difficult to directly compare as some of the language was changed and items with explicit reference to business and employees were removed as not appropriate. Although the data suggests that the PGR cohort as a whole identify with entrepreneurial attributes, those who were currently considering self-employment or business start-up as a career scored significantly higher than those who were not; those with a business idea (but not a business plan) also scored significantly higher than those who did not.

Thirdly, 21 out of the 100 respondents stated that they were considering self-employment or business start-up as a career option, with more respondents reporting they currently had a business idea or business plan, 31 respondents reported having a business idea, for example. Fourthly, respondents were positive towards the importance of enterprise skills development and the inclusion of optional enterprise skills opportunities in the PGR programme of study. Finally, the PGRs in this survey were able to recognise the potential impact of their research on the end user with 20 stating their research had potential for commercial impact and only 3 stating their research would have no impact.

These results give us confidence that University of Huddersfield PGR students are entrepreneurial and see enterprise skills development as important. However, they also show that awareness and take up of enterprise or commercialisation training opportunities are low. By comparing respondents' ratings of confidence in and importance of various enterprise skills, we have been able to identify areas a) where confidence is relatively low and needs to be improved, b) where confidence may not be particularly low, but where there is a large gap between confidence and importance c) where a skill was rated as having lower importance than is optimal from an institutional perspective. This will help us tailor the marketing and prioritise development of skills development opportunities alongside the results of Williams et al. (2013)'s collection of best practice in PGR enterprise and commercialisation skills development form across the UK. Some changes have already been made in the University's provision with the inclusion of a 30 minute introduction to the Enterprising Research in the induction of all PGR students.

The results raise several points of interest for other researchers. Interestingly, the data showed that individuals identify with different terms relating to business. Here, more respondents identified with self-employment as a career option than business start-up; relatively few considered both in their career aspirations. It might be argued that business start-up is preferable to self-employment as growth – at least in terms of employment potential – is more implied. However, in our experience, self-employment is often the starting term used by those with lower confidence in their business abilities and does not necessarily reflect longer-term ambitions. This particular result has implications for assessment of entrepreneurial intent or impact of enterprise and entrepreneurship education initiatives where the term business start-up may be used either as an all-encompassing term, or where the potential for self-employment as an entry point for an entrepreneurial career may be overlooked. It has strong implications for practice for all universities in terms of the language used in the marketing, content of training courses, and advice given through enterprise skills training initiatives and dedicated start-up support. It also has major implications in research around entrepreneurial intent and enterprise education impact as use of the 'wrong' language for the population being studied may affect the responses given and thus the conclusions made.

Further research is required to explore some unexpected results identified in this analysis. Suggestions include:

- Why do some respondents identify with self-employment and others with business start-up?
- Why do some respondents consider self-employment or business start-up as a career option when running a business does not appeal to them?
- Why do others not consider a career in self-employment or business start-up when they currently have a business idea or a business plan that could be taken forward?
- Why is there low take-up of enterprise skills development opportunities by those who are aware of such opportunities when they see development of such skills as important?
- Are the results presented here generalisable to all PGRs or specific to those at the University of Huddersfield? The findings of Lean (2012) suggest that the results found here have wider relevance, but more work is needed and we suggest this work could form the basis for a national survey.

Although the survey asked about potential for commercial and other impact out of PG research, it did not ask about respondents' intentions to take this forward through University routes such as consultancy or spin-out, or actual/perceived barriers and enablers to commercial exploitation. For example, what are the opportunities for exploitation when PGR students do not have employment contracts with the institution they are studying at? What impact do different IP ownership regimes have on exploitation of PG research outputs? Further research is required to explore these issues.

In summary, this paper described the development and analysis of a survey of PGR student enterprise and commercialisation training needs, including items looking at self-reported confidence in a series of enterprise skills and their importance to respondents' future careers; respondents' entrepreneurial attributes; and their current career intentions with an emphasis on self-employment and business start-up options. The results are of relevance to all HE institutions, suggesting that PGR students may be more entrepreneurial and more willing to engage with enterprise and commercialisation activity than expected from the literature and generally held expectations. A warning is given around the use of language used in the marketing of training courses and the development of their content, but also in the language used to research entrepreneurial intent and impact of enterprise programmes as the results here show a difference in groups of students identifying with 'self-employment' and 'business start-up'. The paper also highlighted several issues requiring further research.

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