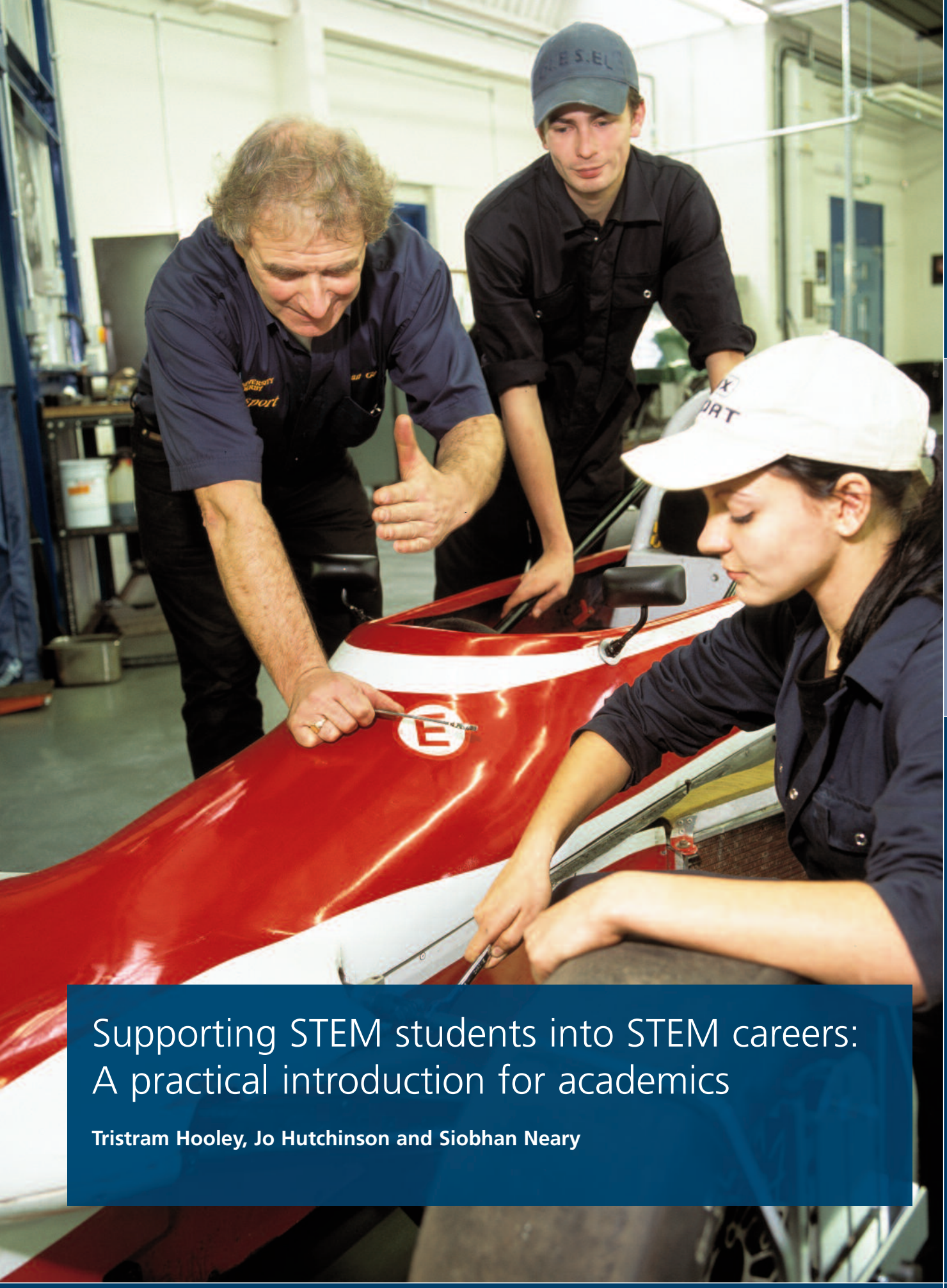


STEM CAREERS

Supporting STEM students into STEM careers: A practical introduction for academics

Tristram Hooley, Jo Hutchinson and Siobhan Neary

UNIVERSITY of DERBY

International Centre for Guidance Studies (iCeGS)

National HE STEM Programme

Authors

Tristram Hooley
Jo Hutchinson
Siobhan Neary

International Centre for Guidance Studies
University of Derby
Kedleston Road
Derby, DE22 1GB
www.derby.ac.uk/icegs

iCeGS

The International Centre for Guidance Studies is a specialist research centre with interest in career and career guidance. It undertakes diverse activity including the evaluation of learning or guidance programmes, comprehensive literature reviews, impact assessments and strategic projects that inform the development of national services. Much of iCeGS' work is applied research to support the delivery and improvement of services. iCeGS undertakes blue skies research that examines the theoretical and conceptual basis of career and career guidance.

National HE STEM Programme

The National HE STEM Programme is an initiative funded by the Higher Education Funding Councils for England and Wales through an activity grant to the University of Birmingham in June 2009. Working across the higher education sector with a particular focus upon the disciplines of Chemistry, Engineering, Mathematics and Physics. The National HE STEM Programme supports higher education institutions in encouraging the exploration of new approaches to recruiting students and delivering programmes of study. It enables the transfer of best practice across the higher education STEM sector, facilitates its wider adoption and encourages innovation. Through collaboration and shared working, the Programme focuses upon sustainable activities to achieve long-term impact within the higher education sector. As part of this philosophy The National HE STEM Programme actively disseminates project outcomes and evidence based good practice to HEIs beyond those involved in the project.

ISBN: 978-0-901437-27-3 June, 2012

Contents

Introduction

Higher education has a pivotal role in an individual's life, it offers an opportunity to learn about life, gain a level of expertise in an academic subject and for many is also a time to make friends and contacts that endure throughout life. Deciding to study a subject at university is also a key career decision and one that underpins much of an individual's future career journey. However, in most cases choosing a subject is not the same as choosing a career and higher education students typically still have a lot of thinking to do about their career. The transition for many students from their undergraduate studies into employment or further study can be challenging. For example 60% of students graduating with a first degree in 2010 went straight into work, while most others are undertaking further study or some other purposeful activity. However, there are also those who become unemployed on graduation for example in 2011 14.2% of computer science and IT graduates, 11.1% of physics graduates, 9.5% of chemistry and mathematics graduates and 8.5% of engineering graduates were unemployed sixth months after graduation.[1] What is more, research also suggests that despite the opportunities in STEM many STEM graduates do not progress into STEM careers.[2]

The paradox for those graduating from STEM subjects is they are in demand with 43% of employers and businesses saying that they have difficulty recruiting people with the STEM skills they need (CBI, 2011)[3]. Consequently there has been considerable public policy discussion around the importance of STEM subjects to the UK economy and the supply of skilled people into STEM relevant sectors.[4] It is not necessary to rehearse this policy discussion in detail here, but it is possible to summarise it as follows: STEM skills and knowledge are important to the economy and at present there is an under-supply of people in this area. What is more there is a 'leaky pipeline' which means that many people who have an interest in STEM subjects do not continue with them throughout their education and into their career. In other words STEM subjects and STEM careers matter to the UK and universities have a role to play as part of the pipeline of STEM skills.

HEFCE has been seeking to stimulate the demand for STEM courses among students through its support for Strategically Important and Vulnerable subjects. While this support can enhance the supply of graduates into the labour market, it cannot route them into STEM jobs and research suggests that STEM graduates miss out on STEM jobs because, while they have high level knowledge, they lack the employability skills that employers are looking for[5]. Universities therefore have a role to play in supporting their students to develop STEM skills and knowledge and consider where they might be best employed in the labour market. This means attending to their career management and employability skills as well as to their subject knowledge.

---

1 HECSU/AGCAS (2011). What do Graduates Do? Cheltenham: UCAS Publications Services.

2 Mellors-Bourne, R., Connor, H. & Jackson, C. (2011). STEM Graduates in Non STEM Jobs. London: Department for Business, Innovation and Skills.

3 CBI (2011). Building for Growth: Business Priorities for Education and Skills. Education and Skills Survey. London: CBI.

4 See for example Roberts, G. (2002). SET for Success . London: HM Treasury; Smith, H. (2007). A Review of the STEM Skills Supply Chain. London: The Council For Industry and Higher Education and House of Commons Committee of Public Accounts (2011). Educating the next generation of scientists Fifteenth Report of session 2010–11 Report, together with formal minutes, oral and written evidence, Available from: http://www.publications.parliament.uk/pa/cm201011/cmselect/cmpubacc/632/632.pdf [Accessed 24 May 2012].

5 DIUS (2009). The Demand for Science, Technology, Engineering and Mathematics Skills. London: DIUS.

The purpose of this guide

Graduate employability is increasingly becoming a selection criteria used by students in their choice of university and discipline. It is also used as a metric for the quality assessment of institutions and the construction of the various league tables produced by newspapers and other media outlets. In addition to identifying levels of employment, further study and unemployment, graduates' employment destinations are classified as "graduate" or "non-graduate" jobs. The distinction between "graduate" and "non-graduate" is also important for the various metrics that are produced from the destinations data.[6] To evidence that a particular course or discipline supports graduate employability it is therefore important not only that graduates are able to find work, but also that they can find work of an appropriate level. A STEM degree should be a clear asset in achieving this aim of finding graduate level employment.

The importance of the STEM skills supply chain, of student employability and of the role of the destinations statistics in student recruitment combine to create a strong rationale for academics to attend to student destinations and to provide some career support for their students. Of course, many academics do this already by working with professional associations, colleagues, careers services, employers and students themselves. For example, some engineering subjects have a strong vocational element and associated links with employers.

Other academics may feel that career management and employability skills are outside of their remit. They have expertise in teaching and researching their subject, but may feel less comfortable for a variety of reasons with taking on roles around offering careers support to students. Yet as the Employability Skills Review[7] demonstrates there are a number of drivers within universities themselves that focus on employability skills and on the issues of employer expectations and skills gaps. This publication has therefore been produced to help academics to think through what their role should be in relation to students' career development. The purpose of the publication is to provide some underpinning knowledge about the area of student career development and the graduate labour market alongside some practical suggestions about how to support students in their career development. It offers some case studies of career and employability related initiatives that demonstrate a range of approaches aimed at enhancing the employability of STEM graduates. It does not seek to prescribe a particular approach but rather to provide some routes in to this area and tools that academics can apply in an appropriate way within their disciplinary context.

The publication is designed to be a practical handbook rather than an academic text. References are provided where they help to clarify the points that are being made. The publication concludes with a further resources section which is not comprehensive but again is offered to provide a number of entry points to explore these ideas further.

6 For a more detailed discussion of the classification of graduates destinations see HEFCE (2011). Approaches to Measuring Employment Circumstances of Recent Graduates. Available from https://www.hefce.ac.uk/media/hefce/content/pubs/2011/201102/11_02.pdf [Accessed 18 May 2012].

7 Toland, A. (2011). HE STEM Employability Skills Review. Birmingham: National HE STEM Programme

Where do STEM graduates work?

As a result of public policy interest in the STEM skills pipeline there is a considerable amount of research about the labour market and career destinations of STEM graduates.[8] Key findings include:

- STEM graduates can be found across the economy in a range of different occupations and sectors. With a few exceptions most STEM degrees do not automatically lead graduates to working in a particular occupation or group of occupations.
- On average, STEM graduates earn more than non-STEM graduates – even when they are employed in jobs outside the STEM sectors.
- STEM graduates are in demand across the economy, not least because the existing STEM workforce is ageing and as much as can be predicted this demand is expected to increase over the medium to long term.
- Science based roles employ a higher proportion of people with postgraduate qualifications than non-science based roles.

In general then, STEM graduates have knowledge that is valued across the labour market. There are also many jobs that require STEM knowledge and expertise. However, not all STEM graduates go into STEM jobs, and there are differences in destinations of graduates from different subjects. The table over the page sets out some information about the destinations for graduates from different subjects.[9] It shows how the subject studied intersects with future employment. For example engineering is far more likely to lead into a STEM employment destination than physics, although physics graduates undoubtedly continue to make use of their skills in roles across the labour market.

The data in the following table is derived from the Destinations of Leavers from Higher Education Institutions survey (often shortened to DLHE). This information is based on destinations six months after graduating and so it shows that in all disciplines large numbers of graduates are in stop gap employment, for example in retail or bar work. This dataset is used to inform the key information sets[10] that are available to prospective higher education students to support their choice of institution. Understanding of graduate destinations is becoming more sophisticated with an increasingly longitudinal focus[11]. Nevertheless, academics may find that improving the immediate destinations of students as recorded in DLHE becomes a key departmental target alongside satisfaction scores from the National Student Survey.

---

8 See for example Wilson, R. (2009). The Demand for STEM Graduates: Some Benchmark Projections. London: Council for Industry and Higher Education; TBR (2011). The Current and Future UK Science Workforce . Newcastle upon Tyne: TBR; Mellors-Bourne, R., Connor, H., & Jackson, C. (2011). STEM Graduates in Non STEM Jobs. London: Department for Business, Innovation and Skills.

9 Information taken from HECSU/AGCAS (2011). What do Graduates do? Cheltenham: UCAS.

10 See HEFCE (2011) Key Information Sets, http://www.hefce.ac.uk/learning/infohe/kis.htm for further information.

11 HESA (2009). Destinations of Leavers from Higher Education Institutions: Longitudinal Survey of the 2004/05 cohort . Cheltenham: HESA.

Graduate Destinations by Degree Subject

Degree Subject	Top three destinations by occupational group 6 months after graduation	Other sample destinations by job title
Chemistry	1. Other professional, associate professional and technical roles (18.2%) 2. Scientific research, analysis and development professionals (17.9%) 3. Retail, catering, waiting and bar staff (15.5%)	Paramedic Accountant Trainee Patent Attorney Officer Cadet International Operations Graduate Tax analyst
Physics	1. Business and financial professions and associate professionals (16.2%) 2. Information technology professionals (12.1%) 3. Retail, catering, waiting and bar staff (11.4%)	Sales Manager Programme Management Graduate Quality Assurance Engineer Sound Engineer Graduate Scheme Engineer Trainee Medical Physicist Jazz Pianist
Mathematics	1. Business and financial professions and associate professionals (36.3%) 2. Retail, catering, waiting and bar staff (12.1%) 3. Education professionals (7.1%)	Advertising Planner E-business Marketing Analyst Quality and Performance Management Officer Supply Chain Manager Mathematician Structural Engineer Games Developer Software Developer
Civil Engineering	1. Engineering professionals (54.6%) 2. Commercial, industrial and public sector managers (8.9%) 3. Retail, catering, waiting and bar staff (8.1%)	Maths Teacher Auditor Service Delivery Manager Shop Assistant Teacher of English as foreign language Graduate Project Manager Civil Engineer Design Engineer
Electrical & Electronic Engineering	1. Engineering professionals (30.9%) 2. Information Technology Professionals (18.2%) 3. Retail, catering, waiting and bar staff (10.4%)	Naval Officer Power Systems Engineer Weapons Engineer Finance Graduate Software Developer Web Designer Care worker Broadcasting Engineer
Mechanical Engineering	1. Engineering professionals (59.4%) 2. Commercial, industrial and public sector managers (9.1%) 3. Retail, catering, waiting and bar staff (6.5%)	Mechanical Engineer Design and Development Engineer Business Analyst Graduate Analyst Reporter Race Engineer Body design Engineer Nuclear Graduate Engineer

Deconstructing DLHE

The Destinations of Leavers from Higher Education Institutions (DLHE) data are gathered through an annual survey of recent graduates. All students are contacted approximately six months after they leave and asked to provide information about the type of work that they are involved in or what sort of further study they may be engaged in. A range of data are collected including information about the industry sector and occupation type that leavers enter and geographical distribution. Much of the data are also linked to data from the HESA Student Record allowing analysis of destinations by students' attributes such as gender, subject of study, qualification obtained and University.

Institutions are asked to get a response rate of 80% for domestic full-time students and lower response rates for other categories of students; 70% of part-time students and 50% of EU students. This slight reduction reflects pragmatic reasons associated with the data collection.[12] The key figures that universities are likely to be concerned about are the percentage of graduates who are unemployed and the percentage who are in a "graduate job" as it is these figures that impact on the perception of the university and influence the institutions' ranking in league tables. Defining what constitutes a graduate job is complex. Elias and Purcell (2004)[13] identified four categories of graduate employment:

- traditional professions i.e. medical practitioners and professional scientific and technical specialists;
- modern graduate occupations i.e. IT, Management and Teaching;
- new graduate occupations i.e. health professionals such a physiotherapists, occupational therapists and management accountants; and
- niche graduate occupations i.e. sports and leisure management and senior administrators.

DLHE is clearly important for Universities and their wider stakeholders including BIS who are likely to use its data as part of their assessment of the quality of courses. Nevertheless, DLHE has its limitations which are worth briefly rehearsing. DHLE provides an immediate snapshot of graduates destinations six months after graduation, but for many graduates their six month destination does not say much about their career trajectory. In particular for those graduates who do not go onto a conventional graduate recruitment scheme, which represents the majority of graduates, it may take them longer to establish their career. Furthermore there are additional challenges in using DHLE as a metric for university performance as the university they attended and the subject they studied are only two factors amongst many more including their own career management skills, their family background, the area in which they live and so on.

12 See HEFCE (2010) Methodology, http://www.hesa.ac.uk/content/view/1602/233/#response for further information.
13 Elias, P. and Purcell, K. (2004) Seven years on. Manchester. Higher Education Careers Service Unit (HECSU).

How do students explore their career options?

By the time that students reach University they have already made a number of career related decisions such as their GCSE and other qualification choices, their preference for academic or vocational qualifications, where they should study after compulsory education, what they should apply to study at Higher Education and where. Their choices are influenced by a range of factors including the educational and occupational backgrounds of their parents, the schools they attended, the status of the local economy of areas they know well, their gender, cultural background and ethnicity. Layered over this is the observation that different people approach career decisions in different ways; longitudinal research with adult decision makers has identified four different types of career decision maker namely evaluative, strategic, aspirational and opportunistic[14]. So different students will explore and make career decisions in different ways.

After a degree in physics, followed by a secretarial skills course, work with the Royal Exchange theatre and employement in computer programming, and at the age of 24 Kate realised she was more interested in audio engineering than computer programming.

Kate Bellingham
Former National STEM Careers Coordinator.
www.katebellingham.com

The issue for students is that although they have already made a number of career decisions by the time they arrive at University, many lack a longer-term career plan or career management skills. A recent study[15] found that many STEM students in their final year have done very little career thinking and have applied for no jobs. However, of those students who have made applications most have applied for both STEM and non-STEM jobs. The same study found that STEM students would like to go into a job that is relevant to their degree but too often have no clear idea about what those might be. It seems that students are not necessarily choosing a career but are rather exploring a range of options and pursuing those options that seem most likely to lead them forwards. The same study also found that the career options that students were considering did not always match their eventual destination, meaning that some students are unable to achieve their career ambitions. Managing a career is clearly a mix of planning and expediency and those STEM students who are actively pursuing their career towards the end of their studies seem to recognise this.

Recent thinking about careers has also tended to emphasise the need for pragmatism and responsiveness to labour market conditions. So the idea of producing a ten-year career plan seems increasingly less helpful, while a "planned happenstance" approach which emphasises the idea of exploring a range of possibilities and responding to opportunities might be more useful.[16]

14 J. Bimrose & S.-A. Barnes (2007). `Styles of Career Decision-Making'. Australian Journal of Career Development 16(2):20-28.
15 Mellors-Bourne, R., Connor, H., & Jackson, C. (2011). STEM Graduates in Non STEM Jobs. London: Department for Business, Innovation and Skills. P.11.
16 For more information about the thinking behind planned happenstance see Mitchell, K. E., Levin, A. S., & Krumboltz, J.D. (1999). Planned happenstance: Constructing unexpected career opportunities. Journal of Counseling & Development , 77 (2): 115-24.

Student approaches to career planning

STEM students are not always well prepared in terms of their career planning during or even after the completion of their degree. A major survey undertaken for BIS of STEM students[17] found that students' career decision readiness (or more simply, the level of their ideas about career) are relatively under-developed. The following information is taken from that report.

"We found nearly a quarter of the undergraduates to have no or only vague career ideas when surveyed almost mid-way through their final academic year. Only around a third of students had a definite career plan by then, with the majority of students considering various options; and just over a third (37%) had applied for jobs (although this was about 60% of those who intend to enter long term employment directly after graduation).

Furthermore, the vast majority had chosen their degree course for reasons other than strategic career thinking. 'Interest/enjoyment of the work' (85%), 'personal interest/aptitude in the subject' (77%) and 'enjoyed studying subject at A-level' (67%) were the main reasons that students gave for choosing their degree course. Conversely less than a a quarter, chose it for 'improved job prospects'. Their experiences at university, and the influences upon them, did appear to have had a generally positive effect in terms of firming up career ideas. However, this pattern varied by STEM subject, with those in Engineering and Computer Science being more definite about career plans generally than others, especially those in the sciences. This is perhaps not an unsurprising result nor one that only applies to STEM students, many graduates leave university with few ideas about the career they will follow and often have unrealistic expectations about the kinds of jobs employers will recruit them to.

What impact does career advice and guidance have on these students' career choices and were there times when these students would have benefited from additional career support? A majority (60%) of final year students had used their university careers service with 39% having used it so far in their final year and 36% in earlier years, although the nature of that use was not specified. Roughly one in seven (14%) had used the careers service in both their final year and earlier. Just over a quarter (27%) reported that they found the careers service very helpful and over half (54%) had found it quite helpful with less than one in five (19%) finding it not very helpful or not at all helpful.

Nevertheless, 60% of final year students reported that they would have benefited from additional career support. Nearly half (48%) would have liked more career support before they went to university and 42% would have liked it more support while they were at university. Tellingly, nearly a quarter of final year STEM students would do a different degree were they, hypothetically, to have their time again.

[17] Mellors-Bourne, R., Connor, H., & Jackson, C. (2011). STEM Graduates in Non STEM Jobs . London: Department for Business, Innovation and Skills.

What is a career?

Before thinking about how the issue of STEM students can be supported into quality careers it is important to get a clear sense of what we mean by the term career. Career is a term that is used in a variety of ways and one which carries a range of social and cultural baggage. For example we talk about "career women", "a scientific career", "career criminals", "career development" and "school career". Each of these uses the term to mean something slightly different. Some people might see career as a series of logical and upward moves within a profession. A slightly broader definition would be to see career as dealing with everything to do with a person's working life. However, it is also possible to see career as the way that an individual combines the all elements of their life including working, learning, hobbies, citizenship, family and friends.

Careers advisers and those in associated professions tend to see career in this broader concept although they are likely to recognise the importance of employment to achieving broader life aims. Broader views of the idea of career reframe career discussions away from simply being about getting a job or being successful in the workplace towards a wider sense of how an individual manages their place in the world. For STEM students this might raise the question of where their STEM expertise fits into their whole life. For example they may not work in a STEM subject but still feel that they have a role as a citizen to contribute to public debates around scientific issues. If we accept this broad definition of career it is then necessary to think about how this personal investigation can be turned into the kind of learning that can take place within the context of a curriculum. One way to achieve this is to break down the learning into a series of learning areas that can be explored within the STEM curriculum.

The classic way to break career learning down is to use the DOTS framework[18]. This synthesises career learning into: Self-awareness, Opportunity awareness, Decision-making and Transition skills.

D	Decision making	Having the ability to make decisions about your career direction and the behaviours you adopt throughout your career
O	Opportunity awareness	Having an awareness of the opportunities and possibilities around you. Most obviously this includes knowledge about learning opportunities and the labour market, but might also include entrepreneurial opportunities and personal opportunities.
T	Transition skills	Being able to successfully move from one role to the next. This includes mastery of the technical processes of recruitment but also includes the ability to understand and adapt to new environments.
S	Self awareness	Having an awareness of your own strengths, weaknesses, interests and preferences. Developing a clearer sense of who you are and what you want from your life is important in developing a successful career.

[18] Derived from Law, B. & Watts, A.G. (1977). Schools. Careers and Community A Study of Some Approaches to Careers Education in Schools . London: Church Information Office.

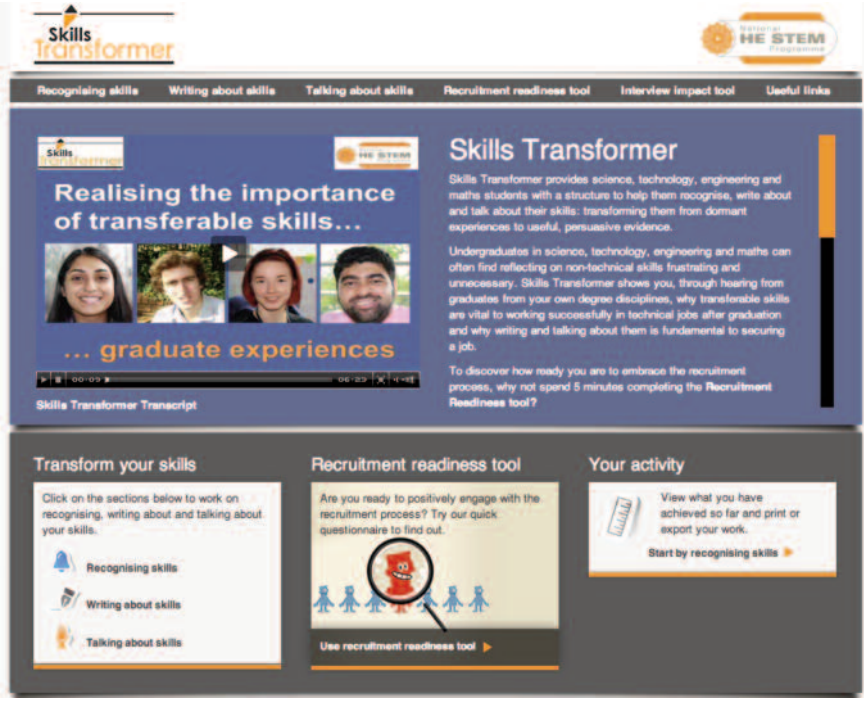
University support for student careers

Higher Education Institutions offer a range of support to all their students through both campus and virtual career services. Often these will cover a range of elements such as:

- One-to-one guidance with professional Careers Advisers
- A comprehensive and up-to-date website covering all aspects of career planning and information about current vacancies
- Departmental talks
- An extensive programme of seminars, workshops, forums and courses to support job search skills, to help students make career choices or to introduce particular professional fields
- Practice aptitude tests and interviews
- Employer-led presentations and skill sessions
- A variety of Careers Fairs targeting different sectors
- Managing volunteering and work experience programmes.

These services are seeking to build the career management skills of all students – to help them to build skills and competencies that will be useful for each and every transition in their future lives and not just their graduate destination. In addition some services have developed programmes specifically for STEM students such as the Skills Transformer; Reading University Careers Centre has developed a site tailored for STEM students to support the development of their transferable skills – the kinds of employability skills that employers seek.

These services are developed within a framework of support for students that goes beyond transitioning from University and into employment. The Blueprint for Careers[19] provides a career management framework within which services can be developed to support students in their careers in the broader sense of the word. Developed by the Learning and Skills Improvement Service (LSIS) the Blueprint has been used by a number of universities to develop and enhance career management skills of their students. More closely linked to employability skills than the DOTS framework, it sets out a core set of competences, which reflect employability skills identified by employers. Careers services at Universities often build these skills within personal development programmes but increasingly they are working with programme leaders and academics to embed career management skills within curricula.



[19] Information about the framework and resources, which might be of use, can be found at http://www.excellencegateway.org.uk/node/1332

Blueprint for Careers

Career management skills are acquired through a range of life experiences. For STEM students this may be through their academic career, work placements, employment or internships. Some of the most effective career management interventions have been those that have been tailored to and embedded in subject areas within the curriculum. The Blueprint for Careers is a new framework designed to support individuals to manage their learning and career. It has been developed by the Learning and Skills Improvement Service[20] (LSIS) in England and builds on international practice from the US, Canada and Australia. The Blueprint provides a framework which defines the career learning competencies that support effective career management.

The Blueprint presents eleven career learning competencies which together support students to develop self- confidence, have a clear idea of who they are, recognise and articulate their strengths, values and motivations.

Blueprint learning objectives

Understanding and developing myself

1. I know who I am and what I am good at
2. I interact confidently and effectively with others
3. I change, develop and adapt throughout my life

Exploring life, learning and work

4. I learn throughout my life
5. I find and utilise information and the support of others
6. I understand how changes in society, politics and the economy relate to my life, learning and work
7. I understand how life, learning and work roles change over time

Developing and managing my career

8. I make effective decisions relating to my life, learning and work
9. I find, create and keep work
10. I maintain a balance in my life, learning and work that is right for me
11. I plan, develop and manage my life, learning and work

The Blueprint has been used in universities in a number of ways to support the embedding of career management skills. It has been used as a tool for students to self assess their career management skills; to provide students with a checklist for their personal and career development; and to provide a framework of learning outcomes for academics who are interested in embedding the development of career management skills within the curriculum.

[20] LSIS (2011) The Blueprint for Careers: Brief Guide. Coventry: LSIS. Available from http://www.excellencegateway.org.uk/node/18469

Programme level development of career management skills

Left to their own devices many students will defer serious attention to their career until almost the end of their time as an undergraduate. This approach can result in the belated discovery that their choices have been narrowed and valuable opportunities missed. For example, graduate recruitment schemes often offer placements at the end of the second year and begin their recruitment processes early in the third year. They tend to look favourably on those students who have already done considerable work to enhance their skills and gather relevant experience. Furthermore in some disciplines the selection of a particular module or project topic might be essential or desirable for students who are going to follow a particular career. Those students who move through their studies without any thought about their future may miss these kinds of opportunities.

Students on programmes of study where career management skills are embedded are less likely to avoid career learning issues. At a module or course level academics are in an ideal situation to support their students' development and to encourage them to consider a range of careers including those related to STEM subjects. Exactly how each academic teaching team chooses to pursue this role is likely to depend on their individual and collective interests, skills and institutional situation. Academics may feel that career and careers advice is something that they do not have an expertise in and that they wish to pass on career queries to others who they feel may be better qualified such as the university careers service. As will be discussed, in some cases this is likely to be the right course of action, however it is also important for all academics to recognise the career expertise that they do have.

STEM academics are successful individuals who have navigated both the worlds of learning and work in order to secure a high status job. A successful academics' career requires a passion for the subject but it also requires them to pursue a number of purposeful strategies to bring their career aspirations to fruition. While many people may feel that they have just ended up in their present role through talent or happy accident, it is very likely that there have been a series of decisions and behaviours that have led them to where they are. Of course the fact that academics have experienced their own careers does not mean that they are careers professionals any more than having been ill qualifies you as a doctor. However, in both cases personal experience does provide a source of empathy and insight that could help someone else. Given this, it is possible to suggest four main roles that academics might fulfil. These are as follows:

- building career management into STEM curricula
- pastoral support and informal advice and encouragement
- referral to other support
- facilitating access to networks.

Career management skills within STEM curricula

The idea of surrendering already busy curriculum space to the examination of career may seem to be a potential distraction from the subject that students have come to study and which academics feel most qualified to teach. It is important to be clear about the role that academics can most usefully play. The careers service is best placed to address some of the queries and issues posed by students, but there is also value in exploring the real work and real work contexts within which academic learning might be applied. It is therefore suggested that any curriculum interventions around career should meet the following three criteria.

1. They should be beneficial to the student in terms of enhancing their knowledge and skills in relation to both the subject they are studying and their career.
2. The career content should be integrated with the academic subject both to justify its inclusion in an academic curriculum and to provide students with a meaningful context within which learning can take place.
3. That the curriculum should be clearly at a HE level and require the same level of intellectual sophistication as the rest of the curriculum.

Curriculum development can be supported in a multitude of ways for example:

- Providing a real-world or work context for some of the learning that is being undertaken can help to engage students in the curriculum as well as stimulating their career thinking. This context or problem based learning approach has successfully been applied in Chemistry degrees in an HE STEM supported programme across four universities[21].
- Encouraging opportunities for placements and internships. Research demonstrates that structured work opportunities enhance students' abilities both in securing work and that it is more likely to be at graduate level.[22] A six week placement preparation activity developed at SHU[23] for engineering and mathematics students for example has been well received by participating students.
- Involving employers in the curriculum and supporting students to build an understanding of the world of work within their academic context can help to support effective transitions. For example the Engineering Graduates for Industry[24] report provides six case studies that show how programmes can integrate applied subject knowledge with learning about employment and career.
- Encouraging students to engage with their professional associations, to build portfolios and to articulate their skills. The University of Reading Transition to Work project is an example of this approach (see next page).

[21] Royal Society of Chemistry, (2011). Context/Problem-Based Learning in Chemistry – Sharing Lessons Learnt & Making it Work; http://www.rsc.org/images/CPBLLeaflet_tcm18-188179.pdf
[22] Cramer, S. (2006). Enhancing graduate employability: best intentions and mixed outcomes. Studies in Higher Education, 31(2): 169-184.
[23] Waldock, J. (2011). Developing Graduate Skills in HE Mathematics Programmes – Case Studies of Successful Practice Mathematical Sciences, Strand of the National HE STEM Programme.
[24] Royal Academy of Engineering (2011). Engineering graduates for industry. London: Royal Academy of Engineering. http://mathstore.ac.uk/node/1808

From Graduate to Chartered Professional

A resource to introduce students to the career and personal benefits of engagement with Professional Bodies and the opportunities to acquire 'Chartered Status (CChem, CPHys, CEng, CMath) has been developed by the University of Reading. The resource should also raise students awareness and understanding of employability skills and the importance of continuing professional development, as well as provide them with the opportunity to carry out some personal career research. The resource has been designed so that upon completion students will be able to:

- List some benefits of engagement with their professional body;
- List some benefits of becoming a chartered professional;
- Explain the basic steps involved in becoming a chartered professional;
- Recognise that some of the competences required of a chartered professional are similar to employability skills expected of graduates;
- Give examples of when they have demonstrated some employability skills;
- Know where to get help in articulating their employability skills;
- Suggest activities they can take part in to improve their weaker employability skills.

Lisa Cranfield who developed and used the resource with students at Reading University says "the resource is ideally suited to second year undergraduate students and has been designed for students to complete as an assignment on an individual basis and introduced as part of a lecture. There is an answer sheet that accompanies the resource and therefore could be made available to students for self assessment. For the section of the resources which requires personal reflection and writing examples of employability skills, students may need feedback on their attempts to articulate their skills. Most of the students who trialled the resources reported difficulty in writing about their employability skills. If this is the case for your students you may want to consider inviting in your career service to run some sessions on articulating employability skills. It may be beneficial to invite a speaker from the relevant professional body in to talk about membership and chartered status as a way of introducing the assignment."

The resource can be found at www.jorum.ac.uk

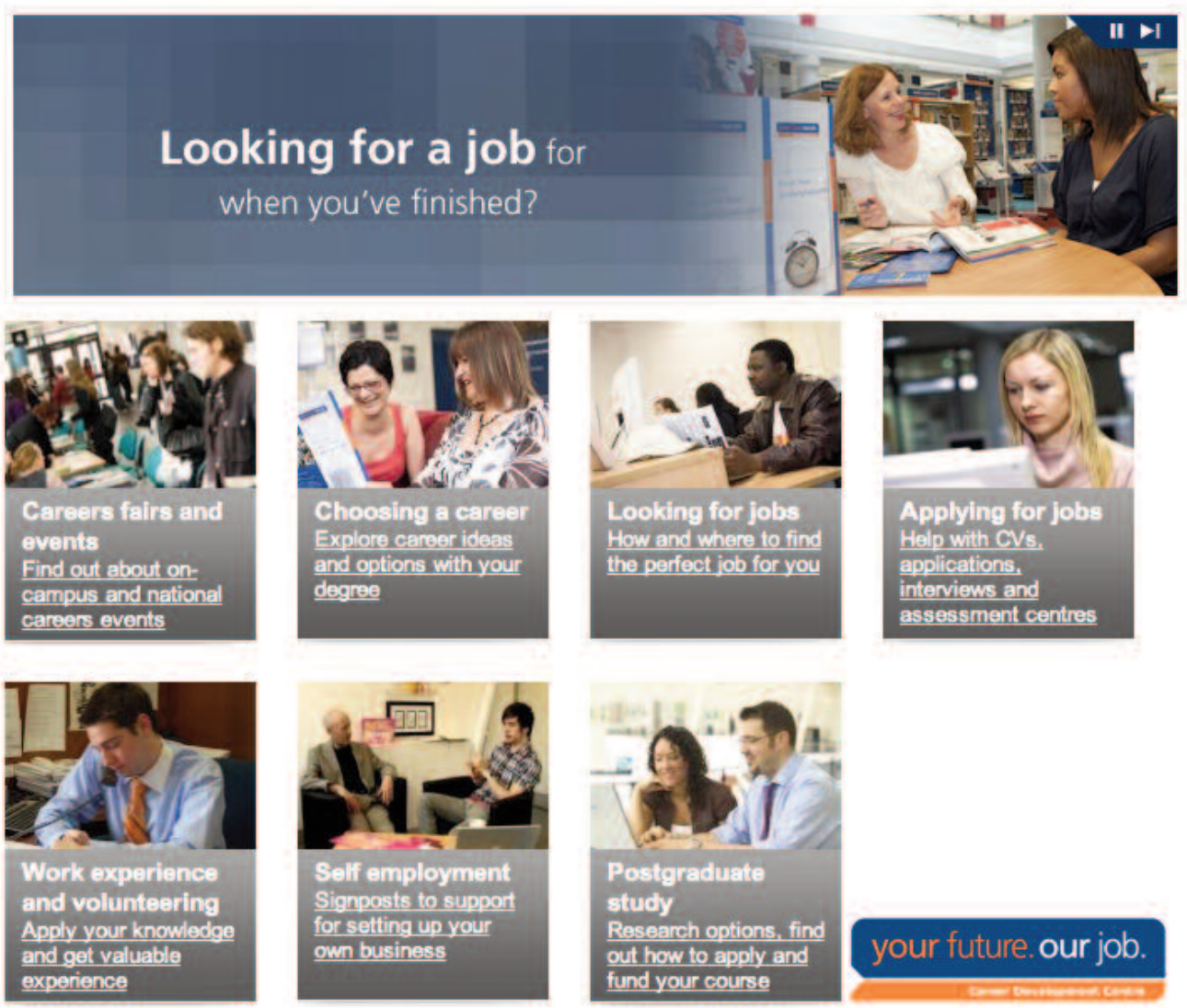
Pastoral support and informal advice and encouragement

Through their teaching many academics will build good relationships and rapport with their students. As such academic staff are often asked by students for advice, which can be on a range of topics related to their studies, their welfare or their future plans. This is what is often described as the pastoral role and in some institutions this relationship might be formalised through a personal tutor system.

In undertaking this pastoral role it is important for both student and academic what the limitations of both parties' knowledge and experience are as the basis of exploring a query so that the basis of any advice is mutually recognised. From here it is possible to provide students with appropriate referral points to continue their career exploration.

There are therefore a number of ways in which academics can support students directly which can include the following.

- Supporting the student in researching and clarifying their ideas more fully perhaps through the destination literature such as publications based on the DLHE survey discussed earlier.
- Sharing personal experiences and those of other students who may have had similar issues.
- Referring students to specialist support services such as the university career service.

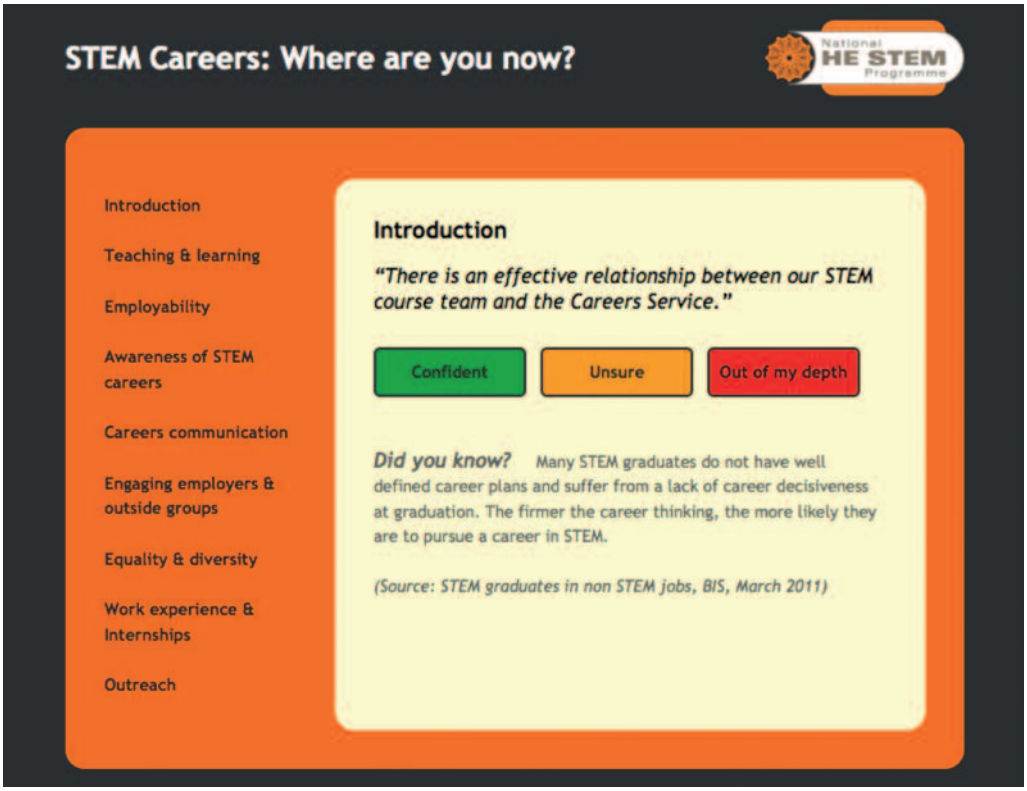


Referral to other support

Most universities have a department that is particularly concerned with students' careers and employability. In many, if not all cases, when a student has a career query then a referral to the careers service would form part of an appropriate response. Some services are part of central student services, others are Faculty based with career advisers being attached to particular programmes of study to provide specialised support for students but also to build links between the careers service and academic colleagues. Careers services are increasingly pro-active in encouraging students to think about careers early and to engage with their service as early as possible. The role of the academic is then not only to refer students who present queries to the careers service, but to challenge students to recognise that they should be thinking early about career, and thus create referrals for their careers services.

Professional associations are a further source of support both for academics and students in their relevant disciplines. The Institute of Physics, the Royal Society of Chemistry, Institute of Mathematics and its Applications, and the 36 Professional Engineering Institutions including the Institution for Engineering and Technology all have resources that are available for both non-members and members. Similarly, Sector Skill Councils such as SEMTA (the Science, engineering and manufacturing technologies), Cogent (Bioscience, Chemical, nuclear, oil and gas, petroleum and polymer industries) and Improve (Food and drink manufacturing and processing) all have extensive information on careers relevant to STEM graduates.

The Centre for Science Education at Sheffield Hallam University identified a need to support STEM lecturers, course teams and careers advisers in HE in developing their own knowledge and awareness of careers in STEM (and in some HEIs also in career related learning and employability skills) in order to support students and to meet the needs of STEM employers. They have developed a simple self-diagnostic tool that allows academics to assess their own knowledge and awareness of employability skills issues as they relate to STEM careers and then presents a comprehensive range of information and resources that can be used to signpost HEI staff towards resources/ case studies for their own development needs. The diagnostic tool can be found at https://extra.shu.ac.uk/cse/dev/sctool/index.html



Networks and networking skills

One of the resources that everyone has in pursuing their career is the people they know. These social and professional networks help with career in a range of ways such as providing useful information, recommendations to others (including potential employers) and providing advice and opportunities to discuss career issues with someone in a similar situation. The nature and extent of an academics own networks will vary reflecting a host of factors, not least the extent to which some degrees are more vocationally oriented than others. Sometimes a student will approach their lecturer with a career idea that they or their colleagues might be able to help with directly. This might be associated with a query about further study or a research career, but could equally be related to links that academics have through previous employment, consultancy and research, and professional association links amongst others. In fact if they are looking for a career in which they can use the STEM knowledge and skills that they have learnt it is highly likely that their lecturers will have some useful contacts.

Networking opportunities you can facilitate could include:

- recommending previous students who might be able to help or can provide access to their networks;
- programme alumni events to allow students to engage with previous students, this helps to create networks, widen out career ideas and provides role models;
- making an introduction to colleagues you may have studied with or worked with at other institutions who may be able to provide specialist knowledge/expertise
- connecting with students via social and professional networking sites such as LinkedIn (www.linkedin.com) and facilitating their engagement with online professional networking; and
- promoting membership of professional associations/groups.

We know that employers recognize that mathematics students often have strong technical skills but lack good communication and presentation skills. So our Mathematics department has adopted a number of approaches to better support students to become more employable.

One of the things we do is to work with the Adab Trust who deliver sessions to better prepare students by building confidence, developing job search skills and increasing their awareness of opportunities. We ensure that our teaching staff are included in these sessions so that they can build on that work.

We also encourage our students to get involved in both university and faculty events and activities such as volunteering for open days, becoming mentors, maths champions and ambassadors. We know that the experience and skills they develop by doing this will help them to perform better at competence- based interviews because they will have examples of how they have used skills in practice to talk about!

We also ask graduate recruiters to give presentations about the mathematics graduates they recruit, and we invite previous students back to talk about their careers and what it is really like being a mathematics graduate in the real world. We do all these activities to support students in providing role models, networking opportunities and broadening out career ideas and options.

We are really pleased because we've noticed that now 2nd year students have increasingly started to apply for internships and work placements during the summer rather than applying for typical part time student jobs.

Noel-Ann Bradshaw, Principal Lecturer in Mathematics and Operational Research, University of Greenwich.

Concluding thoughts

Despite the importance of building meaningful links within the STEM curriculum it is also important to make the point to students that they should be pursuing their career outside of the context of the curriculum as well. Career is an individual journey and one that is likely to deliver greater rewards to the individual who invests more time and thought. While the curriculum can provide underpinning knowledge and inspiration, the student should be encouraged to continue to explore outside of this context.

Further resources

Below are a selection of resources which may support you developing this area of work further.

- The Association of Graduate Careers Advisory Services (AGCAS) http://www.agcas.org.uk/
- Futuremorph http://www.futuremorph.org/
- Future track http://www.futuretrack.ac.uk/
- Graduate Prospects http://www.prospects.ac.uk/
- Higher Education Careers Service Unit http://www.hecsu.ac.uk/
- Higher Education Statistical Agency http://www.hesa.ac.uk/index.php?option=com_collns&task=show_colln&Itemid=232&c=C10018&s=3&wvy=any&wvs=1&isme=1
- Institution for Engineering and Technology http://www.theiet.org/membership/career/index.cfm
- Institute of Mathematics and its applications http://www.ima.org.uk/careers.cfm
- Institute of Physics http://www.iop.org/careers/index.html
- Labour force survey http://www.esds.ac.uk/government/lfs/
- National HE STEM Programme http://www.hestem.ac.uk
- Royal Society of Chemistry http://www.rsc.org/careers-jobs/
- Women in Science, Engineering and Technology http://www.wiset.org.uk/

STEM CAREERS

UNIVERSITY of DERBY

International Centre for Guidance Studies (iCeGS)

National HE STEM Programme