



 **Chemistry** for our **future**
managed by the RSC

The Chemical Skills Pipeline

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The Chemical Skills Pipeline

In recent years there has been widespread concern about a perceived shortfall in appropriately-qualified science, technology, engineering and maths (STEM) graduates to meet the needs of the UK labour market. A wide range of initiatives have been developed to encourage more students to choose to study STEM, and specifically chemistry, at university. However, there is very little comprehensive research-based evidence available on the motivation of students who chose to study chemical science in Higher Education (HE) and what influences their subsequent career decisions.

Developing STEM skills is central to providing the UK with a sound knowledge base on which a robust economy can be built, and for forging new technological innovations that will lead to a sustainable future for us all. Maintaining a world class research community through a steady flow of well trained graduates is central to this effort.

To investigate these issues the Royal Society of Chemistry (RSC) commissioned a study, *Employment of chemical science graduates in the UK*, to research the perceptions of chemical science HE applicants, students and graduates, and identify the experiences and attributes, that influenced their career decisions. The views and experiences of employers in recruiting chemical science graduates were also explored to gain a better understanding of the factors affecting the supply and demand for chemical science graduates.

The methodology

The research was undertaken by the Warwick Institute for Employment Research (IER) and the Higher Education Careers Services Unit (HECSU). The study takes advantage of all available evidence – both quantitative and qualitative – to look at the perceptions and experiences of different cohorts of chemical science students and graduates at six distinct stages:

- As they apply to study chemistry in HE
- At the end of their first year of study
- As final year undergraduates
- Six months after graduation
- Four years after graduation
- Seven years after graduation

General and specialist chemical science employers were also interviewed to find out about their experiences of recruiting chemical science graduates, the types of roles graduates do within their organisations and their perceptions of the skills chemical science graduates possess.

The report draws on secondary analysis of four existing sources of data and uses three new pieces of original empirical research:

1. Futuretrack¹

An ongoing longitudinal survey following 50,000 students from UCAS application until they get their first job. The Futuretrack survey, funded by HECSU and conducted by IER, examines the relationship between HE, employment and how students' views of career options change during their studies.

Stage One focussed on students as they were about to enter HE. Using the data available for chemical science undergraduates the following questions were asked; (1) What are the characteristics of those who apply for and achieve places on chemical science courses and how they compare with the HE applicant population as a whole? (2) Why do individuals chose to study chemical science and related subjects? (3) Who succeeded and who failed in getting places? [2155 of the Stage One respondents included chemistry or related chemical science courses among their UCAS options. Of these 1111 were known to have accepted a place to study chemical science at university.](#)

Stage Two involved recontacting the students a year later where they were asked to evaluate their experiences of HE and what their current careers aspirations were. [556 chemical science students were identified from the Stage Two cohort.](#)

2. Destination of Leavers from Higher Education (DLHE) first destinations statistics²

Destinations data collected by the Higher Education Statistics Agency (HESA) through a survey carried out approximately six months after students leave a Higher Education Institution (HEI). Examples of the information available from this data include the type of work a leaver has entered or what sort of further study they may be engaged in.

[This report makes use of data collected from the 2007 graduate cohort where 1975 respondents possessed a chemistry degree.](#)

3. Class of '99: A study of the early labour market experiences of recent graduates³

In a study funded by the Department for Education and Skills (DfES), half of the 1999 graduate cohort at 38 UK HEIs was surveyed four years after graduation to determine the relationship between the impact of HE on an individual and their subsequent career history.

[Data for 233 chemical science graduates was obtained from this survey.](#)

4. Seven years on⁴

An examination of the work history of graduates from 1995 using data collected seven years after graduation. The study was funded by HECSU and the Economic and Social Research Council.

[173 respondents were identified as chemical science graduates.](#)

5. Telephone interviews

Interviews were conducted with 20 members of the Futuretrack cohort, who had responded to Stage One or Stage Two of the survey. The interviews were used to further examine their career choices, their experiences of the transition to HE and their first year of study. The majority of interviewees had just completed their second year in HE.

6. Questionnaire survey of final year chemical science graduates

UK and Republic of Ireland chemical science final year undergraduates were invited to complete an online questionnaire. They were asked to evaluate their undergraduate experience with respect to; the skills and knowledge acquired, their perception of their career options and the graduate labour market. They were also asked about their early career plans, their future aspirations and how these had been shaped by the advice they received.

[612 students at 56 UK and Republic of Ireland HEIs responded to the survey invitation.](#)

7. Face-to-face or telephone interviews with employers

Representatives from 60 organisations that recruit chemical science graduates were questioned about their recent recruitment experiences, the ease or difficulty of appointing suitable candidates, the types of jobs chemical science graduates did within their organisation and their perceptions of the strengths and weaknesses of chemical science graduates. Two different classes of employers were defined; those who specify that applicants must have a relevant chemical science degree (referred to as specialist

¹ www.futuretrack.ac.uk

² See www.hesa.ac.uk

³ Purcell et al. The Class of '99: A study of the early labour market experiences of recent graduates. London: DfES

⁴ Elias et al. Moving on: graduates three years after graduation. Sheffield: DfEE/CSU

employers), and those who recruit graduates for roles which don't require a specific degree subject but would be suitable for chemical science graduates (referred to as general graduate employers).

Key findings

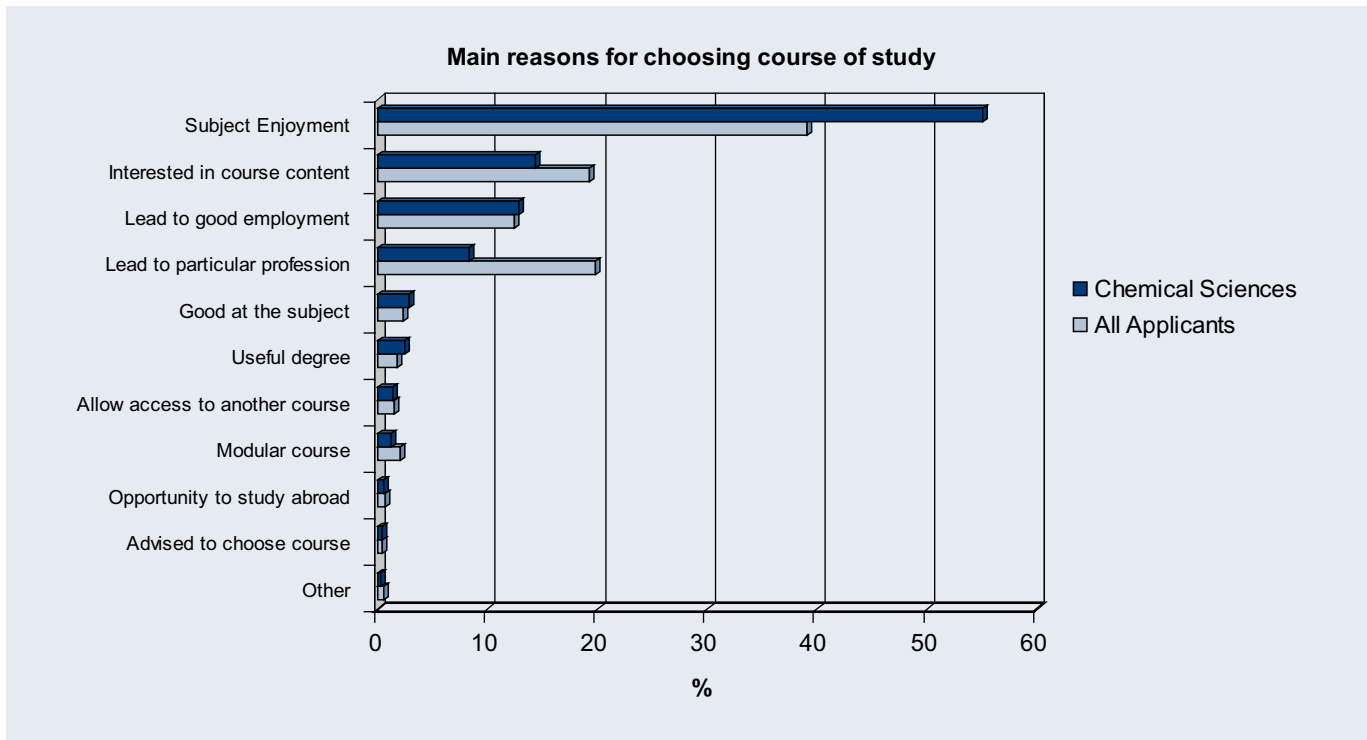
Studying chemical sciences

Early experiences of undergraduate students

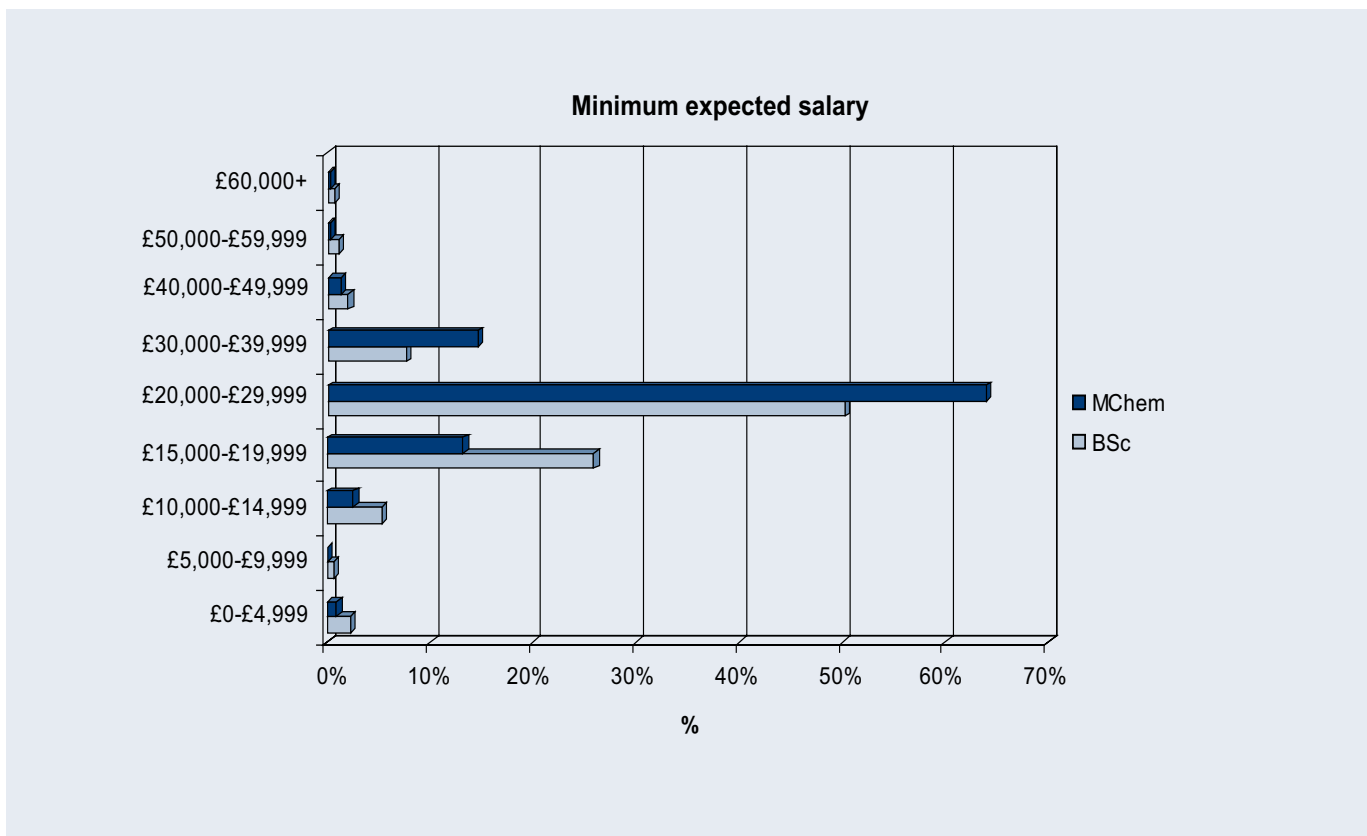
- The report identifies that 61% of 2006 applicants to chemical science courses planned to complete a four rather than three-year undergraduate course. This included both MChem and four year BSc programmes with a year in industry or year abroad.
- When chemical science applicants were asked why they had decided to apply to enter full-time HE, 53% indicated they felt a degree would improve their employment prospects. 18% stated that they wished to study the particular course, and 13% that they wanted to realise their potential. This was in line with the general applicant profile.
- Enjoyment of the subject and an interest in the course were the main reasons applicants chose to study the chemical sciences (69% of all applicants). Only 13% stated that they had specifically chosen this course because they thought that it would lead to good employment opportunities. Chemical science undergraduates were less likely to choose their course for employment-related reasons than the Futuretrack cohort as a whole.
- Students report a high degree of satisfaction with their chemical science courses and with the HE experience in general. 70% of the students stated that they were happy or very happy with their choice of course. This was in line with the general undergraduate cohort.
- The report shows that many chemical science undergraduates embark on their degree without a clear idea of their aim when they complete the course, and view a chemical science degree as a widely applicable qualification.
- At the end of their first year, 52% of the undergraduates reported that going to university had led them to reflect on their future careers; 32% of students said that their career plans were reinforced or much clearer, 13% that they were less clear about what they wanted to do and 7% that their ideas had completely changed. The remaining 48% reported that their career plans were unaffected by their first year.
- Over half of chemical science students had not visited their university or college careers service during their first year, with 12% stating that they were unaware of the careers service at their institution.

What the final year undergraduates think

- Final year chemical science undergraduates believe that students on MChem or MSci degrees have an advantage over those on BSc courses. Students on MChem courses were more likely than BSc students to report that their courses had enabled them to develop the key skills they thought employers wanted.
- Industrial placements were relatively uncommon. Only 15% of respondents studying for a BSc degree and 35% of students on MChem/MSci courses had completed some kind of industrial placement as part of their course.
- Well over two thirds (69%) of students definitely hoped to use their chemistry or scientific knowledge in future employment. The biggest change in students' career plans were reported to be in relation to the branch of chemical science they planned to go into. This reflects exposure to a wide range of options that they were not aware of at the start of their courses.
- Finalists were less likely to think that their courses had helped to develop employability skills such as team-working and communications skills than traditional academic skills such as research skills and an ability to use numerical data. For example, only 49% of students felt that their course had enabled them to develop leadership skills very well, in comparison to 93% believing that their course had helped them to develop research skills.
- Some students mentioned that they found lab work boring and repetitive, which discouraged them from entering particular areas in the chemical science industry because they thought that jobs in this sector would involve a lot of lab work. Even students who particularly enjoyed practical work indicated that they would not like to enter a career where lab work was the only thing they did.
- Only a third of final year students said that they broadly knew what they wanted to do and how to do it, with only 45% seeking careers advice in the previous two years.
- Most students expected that the minimum they would be earning when they graduated would be £20,000 – £29,999. Students on MChem courses on the whole had higher expectations of salaries than their BSc counterparts.
- Ethical considerations were important to several of the interviewees in deciding what career they wanted.



Source: Futuretrack Stage 1, 2006



Source: Finalists enquiry, 2008.

Where finalists have looked for future employment		
	Used (%)	Useful (%)
Graduate vacancy publications/ websites	71.9	51.5
University Careers Advisory Service	47.1	28.1
Recruitment consultancies	34.8	18.4
Speculative approach	33.9	15.4
Specialist publications	29.7	16.1
National press	20.6	5
Local press	19.7	6
Friends or family	17.1	8.7
Job Centre	12.9	3.3
Other	7.4	6.4

Source: Finalists enquiry, 2008.

- Students felt that their careers service could have done more to provide them with specific and detailed information about the types of careers available. Only 28% of students who had used their careers service as part of their job searching strategy rated it as useful.
- Interviewees had a rather negative impression of the information they had received from employers and professional bodies, with the most common complaint being that it was not detailed or practical enough. Less than 15% of finalists in the study sought careers advice from a professional body.
- Despite university career services being the main source of information, 40% of students also gained career guidance from parents and department teaching staff.
- Over half of the students interviewed had started looking for employment. The main areas in which they were looking were healthcare manufacturing (including pharmaceuticals and biotechnology) and fine chemicals (including oil and paints).
- The most common resources students were using to look for vacancies were graduate vacancy publications and graduate vacancy websites. Recruitment consultants were being widely used.
- Work that was interesting and challenging was the most important thing that students looked for when considering suitable jobs.

Moving on

6 months after graduation

- Chemical science graduates were much more likely than other science or engineering graduates to go on to further study, with MChem graduates being more than twice as likely as those with BSc degrees to undertake further study.
- 8% of graduates with a BSc degree were unemployed six months after graduation. This compares to 4% of MChem/ MSci graduates.
- MChem graduates were more likely to go into roles in science than their BSc counterparts, who were more likely to go into management or teaching. First destination data indicate that MChem graduates were twice as likely than BSc graduates to be in a job that requires a degree six months after graduation.
- The data show that six months after graduation chemical science graduates were employed in a wide range of occupations, which demonstrates the versatility of a chemical science qualification.
- 40% of graduates who were employed in chemical science industry found their jobs through recruitment agencies.

Four and seven years on

- Chemical science graduates in their early careers were more likely than graduates as a whole to be in a job where their degree is required. 60% of chemical science graduates reported that their job required a degree seven years after graduation, compared to 54% of natural science graduates and 56% of graduates as a whole.
- More chemical science graduates, than graduates as a whole, were likely to report that they are in a job related to their long-term career plans than graduates as a whole and 86% stated that their jobs provided interesting and challenging work. 73% stated that their role provided opportunities for continual skills development and 62% cited the opportunity to earn a competitive salary.
- Chemical science graduates (43%) were more likely to perceive that they had opportunities for an international career than graduates as a whole (30%).
- The overwhelming majority of chemical science graduates both at 4 and 7 years after graduation were very satisfied, or reasonably satisfied, with their career development to date. This is in line with the general graduate cohort.

4 years after graduation			
	Chemical Sciences graduates	All Natural Sciences graduates	All graduates
Mean annual earnings in current job (2003-4)	£20,990	£20,552	£22,227
Proportion earning < £15,000 p.a.	16.0%	21.3%	17.2%
Proportion ≥ £36,000 p.a.	6.1%	5.2%	8.3%

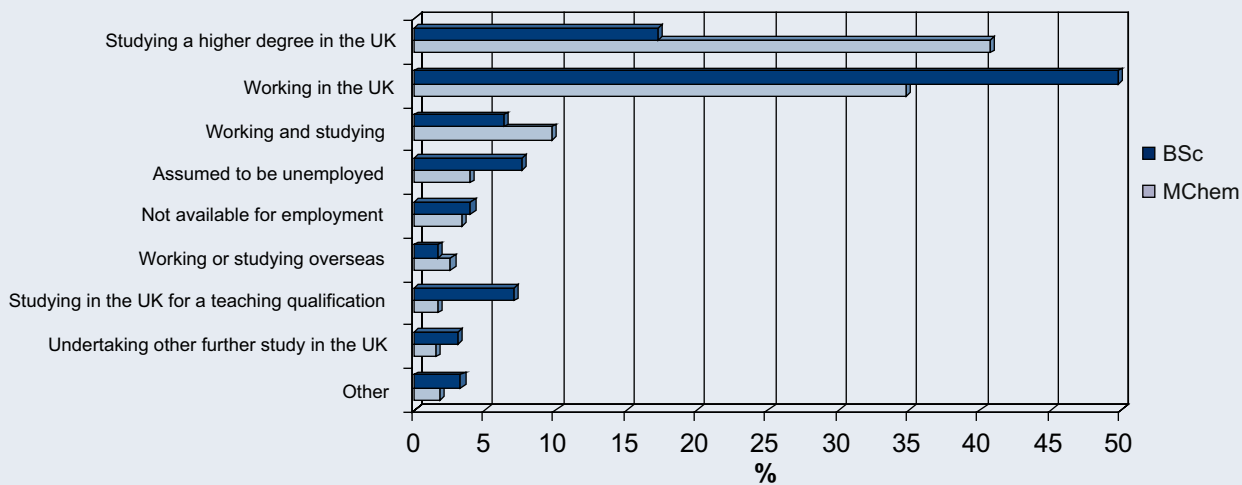
Source: Class of '99 data: IER

7 years after graduation			
	Chemical Sciences graduates	All Natural Sciences graduates	All graduates
Mean annual earnings in current job (2003-4)	£26,354	£23,895	£26,792
Proportion earning < £15,000 p.a.	5.6%	6.9%	10.2%
Proportion > £40,000 p.a.	11.4%	8.6%	14.2%

Source: Graduate Careers Seven Years On data: IER

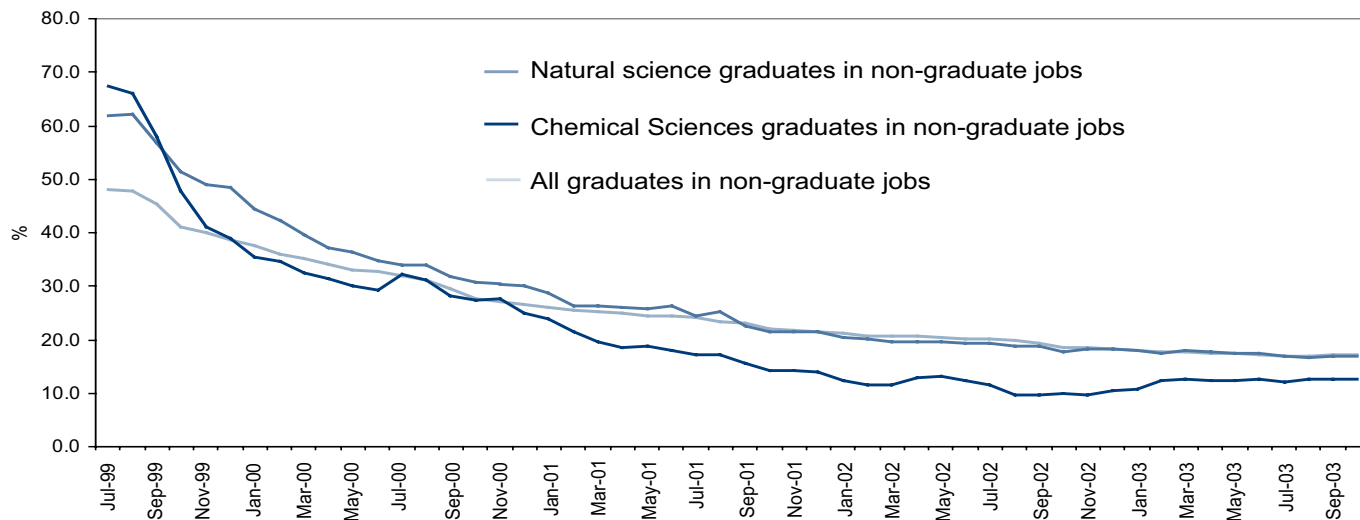
- Chemical science graduates were more likely than other graduates to regularly work as members of a team (73% vs 35%), less likely to report that their work was closely supervised (30% vs 50%) and less likely to work directly with customers or clients (44% vs 65%).
- Mean earnings were not significantly different to those of natural science graduates or graduates as a whole, although fewer chemical science graduates reported earnings in the highest salary bands.
- Comparison of mean salaries four and seven years after graduation shows that chemical science graduates earn more as their careers progress. A lower proportion continue to report earnings in the upper bands; only 11% of chemical science graduates report salaries greater than £40,000 p.a. in comparison to 14% of all graduates.

Activity six months after graduation



Source: HESA Destinations of Leavers of Higher Education, 2006/7

% of graduates in non-graduate employment



Source: Class of '99 data: IER

What employers think

- Interviews with general graduate employers revealed that they are unlikely to favour a graduate with a MChem over a BSc, stressing that they were more interested in the transferable skills that graduates can demonstrate, regardless of the length of their degree.
- In contrast, specialist employers did distinguish between graduates on three or four year courses, with higher degrees in particular being sought for research or academic positions.
- Some employers indicated that they were uneasy about the kind of specialisation they saw as becoming increasingly possible on chemical science degree courses. They were concerned that students were dropping options that were perceived to be difficult or dull – e.g. physical chemistry or mathematics, which employers consider to be vital.
- Employers felt that a range of chemical science skills were in short supply, including physical organic chemistry and analytical science. There was also concern about the ability of graduates to work on large scale research projects.
- The majority of chemical science employers stated that they had no problems in filling vacancies and were satisfied with the number of applications they received. Only two organisations recruiting first degree graduates reported poor application rates for jobs they had recently advertised. Both employers attributed this to their location (one in Central London, offering a relatively low salary, and the other in a rural area). A further five organisations reported problems recruiting suitably qualified PhD graduates or applicants with skills in specialist areas, including analytical chemistry.
- The most popular and effective method of recruitment was felt to be through a targeted approach to particular institutions. Specialist employers tended to target the chemistry department directly rather than the university more generally.
- There was some evidence that employers are making efforts to widen the range of universities they target, but there were questions raised about the content of some degree programmes, and the ability of employers to assess the level and quality of what has been taught.
- Across all sectors the skills employers most looked for were team-work, written and spoken communication skills, problem solving and numeracy.
- Specialist employers felt that chemical science graduates most frequently lacked written and spoken communication skills and business awareness. This was echoed by general employers.
- Employers felt that some chemical science graduates were not aware of the range of options available to them and as a result, were less likely to consider areas with good opportunities such as manufacturing and technical sales. Employers were also critical of students' application techniques, including CV writing and creating a good impression at interview.
- There is a close match between the skills employers thought chemical science graduates lack and those that final year students felt they were unable to develop very well through their degree course:

Employers view of skills lacked by chemical science graduates	Skills finalists reported their courses were not enabling them to develop
Spoken communication skills	Spoken communication skills
Team-work	Team-work
Interpersonal skills	Interpersonal skills
Leadership	Leadership
Presentation skills	Presentation skills
Written communication skills	Creativity
Ability to deal with clients/ customers	Computer literacy
Business awareness and commerciality	Entrepreneurial skills
Self-motivation	Desire to go on learning

Congruence between the skills general and specialist employers perceive as lacking in chemical science graduates, and those that finalists reported that their courses were not enabling them to develop.

Conclusions and recommendations

Important issues have been raised by this report and there are particular areas involving careers information and skills development where the key findings can be used to inform future development of courses and the provision of careers advice. It is essential that these issues are addressed to satisfy the needs of both students and employers, ensuring the continued supply of necessary skills into the scientific and technological market place, and the UK economy as a whole.

Skills development

One major issue arising from the study is the reported lack of 'soft' skills amongst chemical science graduates – including team-work, oral and written communication skills. These types of skills cannot be developed using one-off courses and must be nurtured throughout degree courses without compromising course content. Employers felt that employability skills could be integrated into chemical science degree courses and departments should capitalise on all opportunities to make their graduates employable.

A very small percentage of the undergraduates in the report undertook an industrial placement as part of their course. Placements provide an excellent opportunity for students to develop employability skills, and final year undergraduates expressed concern that not having relevant work experience would hinder them in finding the kind of employment they wanted.

Recommendation 1: Universities should seek to embed soft-skills training within their degree programmes. The implementation of context- and problem-based learning courses could be key to achieving this.⁵

Recommendation 2: Professional bodies should work with employers, universities and other agencies such as Sector Skills Councils to broker the creation and awareness of industrial placement opportunities.

Careers information

Students appeared to lack awareness of the breadth of career opportunities available to them in the chemical sciences. A surprisingly small proportion of undergraduates visited their careers service, and students who did visit stated that they felt that more could have been done to provide them with information about the types of careers available. Interviewees had a rather negative impression of the information they had received from employers and professional bodies, with the most common complaint being that it was not detailed or practical enough and did not feel happy with the service they received. Clearly there is considerable scope to improve the careers advice available to undergraduates.

Recommendation 3: University careers services should do more to raise their profile with undergraduates, who should be encouraged to seek careers advice much earlier in their degree. Particular emphasis should be placed on the importance of students seeking paid or unpaid work experience opportunities.

⁵ See www.cfof.org for examples of context- and problem-based learning resources developed for use in chemical science degree programmes.

Recommendation 4: Professional bodies should work with employers to provide more detailed and relevant careers advice on the type and range of career opportunities available.

Recommendation 5: Employers should develop much closer relationships with career services who can widely promote vacancies and placement opportunities on their behalf.

Recruitment

Employers found that they were able to recruit good candidates from a wider range of universities if they were more familiar with the courses on offer and the skills students could be expected to learn. It is possible that some employers may be missing out on graduates with valuable skills because they are not willing to recruit an individual with an unknown background in the chemical sciences. The report also demonstrated that students themselves need to develop a stronger awareness of the skills they possess and learn how best to promote these during the job application process.

Recommendation 6: Professional bodies should seek to provide clarification for employers on the skills and attributes developed during chemical science degree programmes. They should also promote the range of subject specific and transferable skills acquired by chemical science students. The RSC should also raise awareness amongst employers of the recognition and accreditation of chemical science degree programmes.

Recommendation 7: Universities should seek to develop closer links with employers to raise awareness of the content of their degree courses.

Recommendation 8: Careers services and professional bodies should provide more opportunities for students to develop awareness of their skills and how to promote themselves in CVs, job applications and during interviews.

With an increasing proportion of the UK chemical industry being based within small to medium sized enterprises (SMEs) it is important to recognise the barriers to these companies publicising themselves and their ability to raise students' awareness of their existence and the career opportunities they can offer.

Recommendation 9: Professional bodies and careers services should encourage the representation of SMEs at career events and conferences. This could be achieved through pooling resources where necessary to reduce the financial impact of attending events.

Recommendation 10: Recruitment agencies are growing in popularity, especially with SMEs. Careers services should give advice to students on how to interact with agencies and how to use them effectively to maximise their job searching strategies.

The full report is available for download at www.cfof.org/chemicalskills



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