

*Research Article***Skills and Knowledge Needs Among Recent Bioscience Graduates – How Do Our Courses Measure Up?**

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Date received: 09/05/2005      Date accepted: 10/06/2005

**Abstract**

*A telephone survey was conducted of 2002 or 2003 graduates (942 in total) from various bioscience degree programmes at 4 universities. A structured and scripted interview determined: title/class of degree; nature of current occupation (unemployed, further degree, job) and if regarded as 'career related' post or just 'filling in'; if current occupation was related to degree; three areas of current occupation for which they had been poorly prepared or well prepared by their course. Of the 457 successful contacts, 66 were not currently in any occupation and 121 were taking a further degree (PhD 39, MSc 31, PGCE 20, Medicine 19, others 12). Of the remainder, 144 regarded themselves as in 'career' posts while 123 were 'filling in'. Areas of their current occupation for which their degree course had not prepared them adequately included: practical work (90); careers guidance (42); specialist knowledge (24) and advanced IT applications (21). Areas of their occupation for which they felt they had been well prepared by their course included: the required knowledge base (121); communication skills especially presentations (83); basic IT needs (54); confidence and time- /self- management (43) and relating to people (41). These data are discussed in relationship to recent and current trends in course provision within Higher Education (HE).*

**Keywords:** Skills, knowledge, bioscience graduates, employability, bioscience courses

**Introduction**

For a number of years there have been concerns raised by employers about the quality and adequacy of graduates in relation to their ability to fulfil the requirements of the posts they take up after graduation (Knight and York, 2002; Miller Smith, 2002; Hills *et al*, 2003; Little *et al*, 2003; Lesslie, 2004). These concerns have been addressed in some companies by the provision of training courses in which graduates are brought 'up to speed' in specific areas required in their employment. AstraZeneca, for example, has an extensive training course for new graduates which runs over one year and covers a variety of topics (Higher Education Academy Centre for Bioscience, 2003). Such courses take time and resource and smaller employers may find them

difficult and uneconomic to put on, hence the desire for an 'oven ready and self basting' graduate (Atkins, 1999).

It is clear, however, that bioscience graduates do not all take employment in bioscience jobs, and first destination employment data suggest that only 50% of bioscience graduates are so employed (HESA 2003; Biochemical Society 2003; Graduate prospects, 2003). A large number of diverse employers utilise bioscience graduates and within a cohort of 439 employed bioscience graduates 310 different employers were involved (Hughes, unpublished). While many jobs and employers have similar and generic requirements of their new graduate employees, the number of employers providing bioscience graduates with a diversity of employment makes it difficult to know which employers might provide a representative view on areas in which graduates had not been well prepared. It seemed possible that the more appropriate question concerns the perceptions of *graduates* as to where they have been well or poorly prepared for the occupation they have taken. Such questions have been asked before, and in 1994 pharmacology graduates identified a number of imbalances between what was taught in their courses and what was required in their current occupation (Hughes *et al*, 1997).

The present survey has attempted to identify those aspects of their current employment where recent bioscience graduates feel they were either well or poorly prepared by their course. This information will be of use both with respect to identifying areas of courses which may need more emphasis and also to inform on the appropriateness of a number of trends in educational provision which have become apparent in bioscience higher education over the last few years.

### Data collection

Between 6/07/04 and 2/09/04, the four participating universities, Wolverhampton, Lincoln, Leeds and Newcastle, each employed staff to carry out a structured telephone interview of bioscience graduates from 2003. One university surveyed both 2003 and 2002 graduates. Training was provided, as was practice in use of the structured telephone interview before data collection was started. Initial contact telephone numbers were obtained from the records held by the university, which enabled contact to be made either directly or through further contact numbers supplied by the initial contact. The interviewers recorded the responses to the structured interview questions (full version of structured interview available <ftp://www.bioscience.heacademy.ac.uk/forms/coursesurvey.pdf>) on interview record forms, numbered these consecutively and returned them to the co-ordinating institution (Leeds). Up to four attempts were made to contact each graduate at various times over the survey period. In outline the questions asked involved:

- University attended
- Sex
- The title and class of degree
- The nature of current occupation (unemployed, further degree, job)

- If current occupation was regarded as a 'career' post or just 'filling in'
- If current occupation was related to degree taken
- The three areas of their current occupation for which they had been poorly prepared by their course
- The three areas of their current occupation for which they had been well prepared by their course

### **Data processing**

The data from individual interview records was transformed into a tabular database. Some respondents (<1 %) withdrew before the end of the interview, and so some items are incomplete. However, each graduate's data has been included as far as it was available. Graduates who were intercalating a bioscience degree in the context of a medical course (6) were identified separately and were excluded from the processed data, where indicated. Inspection of the records of the verbal responses showed some recurrent themes had been identified although, as might be expected, different sets of words had been used by respondents to express the same meaning. Where this was clear, such responses have been grouped under a single heading. Other responses were individual to particular respondents. Not all respondents identified three areas of course strength or weakness.

Totals, means and percentages of respondents at all four institutions are reported. Data for each individual institution are reported to demonstrate the variation in the responses. In order to prevent association of particular information with specific universities, these data are presented each time in rank order, and not in any consistent order with respect to the four participating institutions. Comparisons are in any case of dubious validity due to the different degree programmes included and possible differences between the make up of the sample of graduates actually contacted.

## **Results and discussion**

### ***General characteristics of surveyed population***

The numbers of students graduating from the four institutions in the various Bioscience subjects are shown in Tables 1 and 2 below.

**Table 1** Showing the distribution of graduates and those contacted successfully between the four institutions involved in the survey

<b>Institution</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		<b>All (total and/or percentage)</b>	
<b>Year of graduation</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>	<b>2002</b>		
Graduates	184	120	300	174	164	942	
Graduates contacted	76	84	111	113	73	457	49%
M	14	15	50	43	37	159	35%
F	60	69	61	70	36	296	65%
<i>Not disclosed</i>	2	0	0	0	0	2	

The numbers graduating from each institution were not equal, the percentage of graduates from each institution who were successfully contacted by the survey teams varied between institutions and, in each case, was significantly less than 100% (37%, 41%, 55%, 70%). In one university, data were obtained from cohorts graduating in 2002 and in 2003, both of which were included. Because of these factors, the sample may be not representative and it may also be that conscientious or successful graduates, or those in discipline-related jobs, may be easier to contact. Therefore, the data are not necessarily representative of the entire bioscience student cohort at each institution and even less so with respect to all bioscience graduates. The data should not be over-interpreted nor can firm generally applicable conclusions necessarily be drawn. Nevertheless, the substantial number of graduates contacted and the clarity of the major views expressed do make the data and conclusions worthy of further consideration.

The degree profile of the graduates contacted is shown in Table 3. Overall more than 95% were honours BSc graduates. Of these 67% obtained a 'good honours degree' i.e. First or Upper Second, the percentages in the four universities being reasonably consistent (70%, 68%, 67%, 64%).

**Table 2** Showing the titles of the bioscience degrees included in the survey

<b>Institution 1</b>	<b>Institution 2</b>	<b>Institution 3</b>	<b>Institution 4</b>
Biomedical science	Animal science	Biology	Physiological sciences
Biomedicine (BSc & MSc)	Equine science	Zoology	Pharmacology
Biomedical science & health science (BSc & HND)	Equine sports science	Animal nutrition and physiology	Biomedical sciences
Biomedicine & human biology	Horse studies (HND)	Physiology	Genetics
Microbiology	Animal management & welfare (HND)	Medical microbiology	Human genetics
Exercise science and human biology	Criminology & forensic science	Medical sciences	Medical microbiology
Biomedicine and pharmacology	Forensic science	Sports science and physiology	Biochemistry
Rehabilitation studies	Health studies	Biochemistry	Molecular biology
Clinical biochemistry (MSc)	Food studies	Pharmacology	Medical microbiology and immunology
Biological science	Health studies and psychology	Animal science	Microbiology
Biochemistry & biomedicine		Sports science	
Biological science (PGCE)		Human biology	
Biochemistry with molecular biology		Microbiology	
Genetics and microbiology		Biochemistry with molecular biology	
Education & biology		Neuroscience	
Applied biology		Genetics	
Biology and computing		Microbiology with immunology	
Biology		Biotechnology	
Biochemistry with food science			

**Table 3** Showing the degree profile of graduates responding to survey

Institution	1	2	3	4		All (total and/or percentage)	
Year of graduation	2003	2003	2003	2003	2002		
Degree profile							
MSc	7	0	0	0	0	7	1.5%
HND	1	6	0	0	0	7	1.5%
PGCE	3	0	0	0	0	3	0.6%
Not disclosed	1	0	0	0	0		
Total BSc	64	78	111	113	73	439	96.1%
1 <sup>st</sup>	6	8	6	15	12	47	10.7%
2(i)	39	39	70	68	29	245	55.8%
<b>'Good' honours degree</b>	<b>45</b>	<b>47</b>	<b>76</b>	<b>83</b>	<b>41</b>	<b>292</b>	<b>66.5%</b>
2(ii)	13	25	28	30	29	125	28.5%
3	1	1	4	0	2	8	1.8%
Pass	1	0	0	0	1	2	0.4%
Diploma	1	0	0	0	0	1	0.2%
Unclassified	1	0	1	0	0	2	0.4%
<b>Not 'good' honours degree</b>	<b>17</b>	<b>26</b>	<b>33</b>	<b>30</b>	<b>32</b>	<b>138</b>	<b>31.4%</b>
Unknown	2	5	2	0	0	9	2.0%

### **Current occupations**

The current occupation (if any) of the contacted graduates was part of the survey. Overall, 26% of graduates were involved in taking an additional degree and although this overall value is close to that found by others (28.9%; Graduate prospects, 2003: 25%; Yorkshire Futures, 2000) there was considerable variation between the participating institutions (43%, 29%, 13%, 7%). The distribution among types of additional degree is shown in Table 4.

**Table 4** Showing the types of further degree/course taken by responding graduates

Institution	1	2	3	4		All (total and/or percentage)
Year of graduation	2003	2003	2003	2003	2002	
Parameter						
No. doing further degree/course	22 28.9%	11 13.1%	8 7.2%	53 46.9%	27 36.9%	121 26.5%
PhD	4	4	1	21	9	39
MSc	8	5	1	15	2	31
MA	0	1	0	1	0	2
BSc	1	0	0	0	0	1
PGCE	6	0	4	4	6	20
Diploma	3	1	0	2	2	8
Medicine*	0	0	1	10	8	19
Nursing	0	0	1	0	0	1

\* Including dentistry

For the purposes of this analysis, all graduates taking further degrees were regarded as in an occupation (i.e. employed) whatever degree they were taking and irrespective of whether they were, in fact, a salaried research assistant while registered for a higher degree or were remunerated as a research student.

Some graduates were unemployed (defined here as not in an occupation; average 14.7%) and the percentage varied between participating universities (8%, 13%, 14%, 22%). It must be emphasised, this is a 'snapshot' view which includes graduates in a 'gap' between, for example, the successful completion of a PGCE and actually securing employment as a teacher as well as those travelling by choice and therefore not looking for a job. Indeed a recent MORI poll (Unite, 2005) shows that approximately 19% of students express the intention of travelling after graduation and a local unpublished poll in one participating university confirms this figure. When graduates travelling by choice were excluded the data reduce to 4.5%, 7%, 7% and 9%, all of which were close to the mean value (7.0% overall) and in agreement with other reported values (6.5%; Graduate prospects, 2003).

Some students (6) were intercalating and therefore returned to their medical course after graduation. These were excluded from this section of the analysis. Graduates in an occupation (380) were asked if they viewed their occupation as 'filling in' (129; 34%) or as a 'career-type job' (251; 66%) and if either was related to the discipline they studied (234; 61%). The ratio of employed graduates 'filling in' to those in 'career jobs' varied more than 10-fold between universities (0.11, 0.32, 0.86, 1.53; overall 129/251=0.51) and this difference was still apparent when graduates doing any form of further

degree were excluded from the data (0.14, 0.80, 1.18, 1.60; overall  $123/144=0.85$ ). The largest difference may reflect the vocational nature of the degree courses at one institution. As might be expected, a greater proportion of 2002 graduates were in career type jobs (fill/career ratio  $15/28=0.53$ ) than was the case for 2003 graduates (ratio  $22/18=1.22$ ). Nevertheless, it was surprising to see that even 2 years after graduation about one third of employed graduates considered themselves to be 'filling in' rather than in 'career jobs'. This may reflect the fact that fewer graduates are job-hunting whilst at university. In one survey, 60% of students had not made a single job application before sitting their final exams, this figure being nearly double that reported in 2000 (32%) (Grad Facts 2002).

The diverse level and nature of employment of bioscience graduates is well documented elsewhere (Graduate prospects, 2003; Annual survey of UK biochemistry graduate employment, 2003).

### **Degree class and occupation**

It was also possible to examine the effect of degree class on success in obtaining a 'career' related job. Excluding those unemployed and intercalating the numbers with a BSc 2(i) or above and with 2(ii) or below in career type jobs and in non-career type jobs are shown in Table 5. The ratio of 'filling in' job to 'career' job for those with a 2(i) and above was 0.45 while for those with a 2(ii) or below was 0.82 indicating that those graduates with 2(i) or above are about twice as likely to obtain career related employment. However, these data include graduates taking additional degrees which would be expected to be related to career objectives. When these graduates are discounted the ratios become 0.83 and 1.06 respectively indicating those with the better degrees are still more likely to be in career type jobs though the difference is not as large.

**Table 5** Showing the numbers of graduates in 'filling in' jobs (fill) and those in 'career' jobs (career). The upper data represent all graduates except those not in an occupation. The lower data represent all graduates except those in no occupation and those taking further study

Institution	1	2	3	4		All (total and/or percentage)
	2003	2003	2003	2003	2002	
<b>Parameter</b>						
<b>BSc degree; all minus unemployed</b>						
≥ 2(i) 'career' job	39	25	26	54	28	172
≥ 2(i) 'non-career' job	3	15	33	16	10	77
<i>Ratio fill/career</i>	<i>0.08</i>	<i>0.60</i>	<i>1.23</i>	<i>0.30</i>	<i>0.36</i>	<i>0.45</i>
≤ 2(ii) 'career job'	12	9	8	12	24	65
≤ 2(ii) 'non-career job'	4	15	18	11	5	53
<i>Ratio fill/career</i>	<i>0.33</i>	<i>1.66</i>	<i>2.25</i>	<i>0.92</i>	<i>0.21</i>	<i>0.82</i>
<b>BSc degree; all minus unemployed and further study</b>						
≥ 2(i) 'career' job	22	16	23	13	12	86
≥ 2(i) 'non-career' job	3	15	31	12	10	71
<i>Ratio fill/career</i>	<i>0.14</i>	<i>0.94</i>	<i>1.35</i>	<i>0.92</i>	<i>0.83</i>	<i>0.83</i>
≤ 2(ii) 'career job'	7	8	7	10	16	48
≤ 2(ii) 'non-career' job	4	15	17	10	5	51
<i>Ratio fill/career</i>	<i>0.57</i>	<i>1.87</i>	<i>2.43</i>	<i>1.00</i>	<i>0.31</i>	<i>1.06</i>

### **Preparedness for occupation requirements by degree course**

One of the important objectives of this survey was to identify areas of work in their current occupation for which graduates had been

- a) poorly prepared by the course they had taken (Table 6)
- b) well prepared by the course they had taken (Table 7).

Some graduates did not identify any area in which they had been badly or well prepared (21%, 24%, 30%, 36%; overall 26%). No assumptions can be made about these 'nil' responses and while it is possible that graduates felt that no area fell into the well- or poorly-prepared categories it is also possible that a 'nil' response was a strategy to limit their time commitment and bring the interview to a close. It is interesting that more graduates identified aspects where they had been well prepared (290) than aspects for which they had been poorly prepared (219). This may reflect a real difference or it may be that a sense of loyalty to their institution led to under-reporting of aspects for which graduates had been poorly prepared.

Some small number of identified areas related more directly to the organisation of the course they had taken rather than its appropriateness as preparation for the job they were doing. For example: *"the Mind Myths module was a waste of time"*; *"too many students in work groups"*; *"the oppressive computer clusters should have more windows"*; *"more personal contact needed"*; *"feedback too impersonal"*. These were all single isolated comments, no consistent theme was identifiable and although included numerically in the 'others' group in Tables 6 and 7 they have not been analysed further.

As can be seen from Table 5, a varying percentage of respondents identified particular aspects of their current jobs for which they had not been well prepared. In the text below the **number** of graduates commenting on particular aspects is given. In Tables 6 and 7 this number has been expressed as a **percentage of the graduates who identified aspects for which they had been prepared poorly** (Table 6) or **well** (Table 7). This approach has been adopted since, as detailed above, it cannot be assumed that graduates who were successfully contacted but identified no particular aspects were wholly happy with the contents of their programme as would be implicit in Table 6 if the number identifying an aspect where preparation was poor had been expressed as a percentage of those contacted. Still less is it appropriate to express data as a percentage of the total number of graduates from the participating universities.

**Table 6** Showing the numbers of graduates specifying particular areas of their occupation for which they had NOT been well prepared by their course. The percentage figures are derived as a percentage of the number of graduates from each institution or in total (219) specifying any BAD item; OR, as indicated by the \*, the whole number of responding graduates from each institution or in total (457)

Institution	1	2	3	4		All (total and/or percentage)
	2003	2003	2003	2003	2002	
Parameter						
No good or bad item specified *	23 30.3%	30 35.7%	27 24.3%	29 25.7%	10 13.7%	119 of 457=26%
				Overall 21.0%		
<b>BAD: total specifying any (items)</b>	36 (56)	36 (48)	43 (63)	54 (85)	50 (64)	219 (316) = 1.44 items/ response
Practicals (all)	23	7	5	30	25	90 41%
Practicals (excluding further degree takers)	13	5	4	10	14	46 21%
Careers guidance (total)	8	7	7	10	10	42 19%
Filling in/career	2/6	6/1	5/2	4/6	2/8	19/23
Advanced IT	2	5	9	2	3	21 9.6%
Statistics/maths	6	1	0	4	3	14 6.3%
Finance/business	1	6	8	0	3	18 8.2%
Specialist knowledge	1	6	6	7	4	24 10.9%
Placements/final year projects	0	3	7	4	5	19 8.6%
Overqualified/ too high level/ irrelevant	3	1	1	1	1	7 3.2%
Others	12	12	20	27	10	81 25.6%
	Experimental design	Confidence				
	Chemistry	Biochemistry	Chemistry	Chemistry		
	Health & safety	Health & safety 2				
	Support 2					
	More presentations	More presentations	Presentations	Presentations 4	Presentations 2	
	Entrepreneurship	Assessing others				
		Fulltime work very hard work 2	Fulltime work very hard work 5			
		Specialist qualification	Accreditation/ specialist qualification	Accreditation/ spec. qual. 6	Accreditation/ spec. qual. 1	
			Selling/ customers 5			
			1 to 1 discussion 1			
				Report writing (big) 3	Report writing (big) 2	
				Confidence 2	Confidence -	
				Good laboratory practice 0	Good laboratory practice 1	

**Table 7** Showing the numbers of graduates specifying particular areas of their occupation for which they HAD BEEN WELL prepared by their course. The percentage figures are derived as a percentage of the number of graduates from each institution or in total (290) specifying any GOOD item; OR, as indicated by the \*, the whole number of responding graduates from each institution or in total (457)

Institution	1	2	3	4		All (total and/or percentage)
				2003	2002	
Parameter						
<b>GOOD total specifying (items)</b>	51 (94)	51 (103)	78 (186)	65 (94)	45 (56)	290 (533=1.84 items)
IT	3	12	30	6	3	54 19%
Presentations communication skills	18	13	33	16	5	83 29%
Relating to people	5	10	17	8	1	41 14%
Data handling/ statistics	0	4	15	2	2	23 8%
Final year project	2	0	3	20	16	41 14%
Theory base	26	29	29	24	13	121 42%
Placements /practicals	4	11	11	3	6	34 12%
Confidence; time/self management / organisation	8	11	21	3	0	43 15%
Report writing	8	1	9	2	0	20 7%
Others	20	12	18	10	10	
	Critical evaluation			Critical evaluation 1	Critical evaluation 0	
	Analysis	Analysis 2		Analysis 2	Analysis 1	
	Research	Research 3	Research 3	Research 1	Research 0	
	Continued learning 3					
		Health and safety 3				
			Initiative/ independence 2	Initiative/ independence 1	Initiative/ independence 0	
			Careers guidance 3	Careers guidance 2	Careers guidance 1	
			Hard work attitude 2			

**A1). Practical work (90 out of 219 commenting)**

Lack of practical work and experience stood out as the aspect of courses to receive most criticism. Graduates commented: '....never done PCR and only ever seen one'; 'the general lack of lab experience was a problem'; 'lab work very lacking. Lab project in final year was only real experience'; 'not enough hands-on stuff'. Graduates were critical of the amount as well as the level of practicals, their appropriateness, the age of the equipment and techniques which were taught as well as overcrowding in lab classes. The weight of graduate opinion in this area was striking. Even when graduates entering further degrees were excluded there were still many graduates who were dissatisfied with their practical skills (4, 5, 13, 24; overall 46 = 21% of those specifying). There has undoubtedly been a general reduction in the provision of practical work in university courses in response to staff pressures, resource pressures and increased numbers of students. Practical work has also been sacrificed in order to make space for time to teach and practice the generic skills important to employers. However, there is a clear message from graduates that preparation for practical work is inadequate. One commented 'it was not pointed out that I was using a pipette incorrectly until I started my PhD' which raises the issue of careful supervision of laboratory work, the numbers in the lab and staffing levels. Quoting from a recent HEFCE consultation paper (HEFCE Nov 2003), "Employers expect bioscientists to have significant practical experience, and so there is pressure to ensure that the amount of practical work is not reduced" "....Reducing practical work in the biosciences would undoubtedly have an adverse effect on HEFCE employability objectives". The responses from the survey reported here suggest we have already arrived at this situation!

There are a number of options which would increase the practical content of courses. For example total teaching time could be increased, time spent teaching generic skills could be reduced or students could be given options for 'practical-light' or 'practical-heavy' modules.

**A2). Career management/guidance (42 out of 219 commenting)**

Career management was consistently identified as an area where courses had not prepared graduates adequately. Graduates commented '*You come out of Uni expecting to walk into a job but in actual fact all graduates have the same experience and so the realisation that you need more at an early stage would be good*'; '*the chance to hear more from people in industry, what they actually do, would have been good*'. Several graduates emphasised the need for this to come early in the course and to incorporate course/programme management and the implications of making particular module choices. This may be especially important now 'practical-light' and 'practical-heavy' modules are options at some universities. Graduates in 'filling in' jobs (19 out of 129 = 15%) as well as in 'career type' jobs (23 out of 251 = 9%) were both critical of their preparation in this area. Table 6 also shows that some graduates included career management as one of the good features of their courses and this divergence may reflect the extent to which the students made use of the services available to them (for example, from their Careers Service), the interests of particular tutors (since career management is sometimes included

within the personal tutorial system) or the extent to which it is included in personal development portfolios as suggested by Clegg (2004).

An issue which was mentioned by several graduates concerned courses which were or were not accredited by the appropriate professional body. Some graduates only appreciated the significance of this matter when they applied for particular jobs which clearly points to the need for more up-front information and an improved understanding of this aspect among applicants to university courses. Indeed, one graduate commented that *“if I had understood the significance of the course not being accredited I would have taken a place at a different university”*.

### **A3). Specialist knowledge (24 out of 219 commenting)**

Specialist knowledge was also identified as a deficiency though it is perhaps unrealistic to expect relatively generic courses to prepare all graduates with detailed specialist knowledge required in particular jobs. For example: *“dressage”*; *“the microbiology of biscuits”*; *“attaching trailers to vehicles”*; *“betting odds and how to settle bets”* and *“police ranking structure”* were singled out. The two latter items do lead to some speculation as to the circumstances behind the identification of the need for more knowledge in these areas!

### **A4). Advanced information technology (21 out of 219 commenting)**

Advanced IT was also identified as a deficiency. It does, however, seem unrealistic to expect graduates to be given knowledge of very specialist (perhaps custom-written for the company) software used in particular employments or of software packages (e.g. SAGE accounts software; Graphit software; reference management software; laboratory management software) which might be alternatives to that used in a particular university.

### **A5). Placements and final year projects (19 out of 219 commenting)**

It was surprising to see placements and the final year project identified in this section but it was generally the LACK of placements or lack of choice of PRACTICAL final year projects which was felt to be inadequate. A graduate commented: *‘There was not enough lab space for practical projects – unfortunately I had to do a lit project’*. This emphasises and re-enforces the views on the inadequacy of the preparation received by graduate for practical work.

### **A6). Business and finance information (18 out of 219 commenting)**

Finance and business knowledge were also listed. Graduates commented: *‘the business side was unknown to me’* and *‘commercial awareness was lacking’*. These inadequacies were perceived not just by those graduates running their own businesses but those employed by big companies also felt inadequately prepared about the business process, costs, budgets and balance sheets. Commercial awareness has been identified by others as something poorly taught at university (e.g. Doctorjob.com, 2004). It is interesting that one university has introduced a commercial awareness module within the last few years.

B). With regard to the areas where graduates were well prepared by their courses:

**B1). Knowledge base (121 out of 290 commenting)**

The theory and knowledge base provided to graduates was clearly very appropriate. Many commented favourably on the broad nature of the material covered in courses as well as its appropriateness. Graduates commented: *'the theory was good for underpinning everyday work'*; *'use the knowledge learned at uni on a daily basis in job'*; *'theory aspects of job were done at uni in depth and were well covered'*. Two students commented that the level of knowledge was more than was required for their jobs but this view was a tiny minority.

**B2). Presentations/communication skills (83 out of 290 commenting)**

Training in presentation skills and communication was very well regarded, as was training in basic IT skills (web, PowerPoint, Word, Excel etc). Graduates commented: *'I was well able to discuss work with others at different levels'*; and *'talking, presentation side of it and working in groups prepared me well'*. A minority would have liked more opportunity to practice presentation skills but again this was a view expressed by very few, and it is possible that these graduates had not made the most of the opportunities presented to them as part of their course.

**B3). Confidence and time/self management (43 out of 290 commenting)**

Confidence building (particularly related to oral presentations), organisational ability and time management was also well provided as was team working and dealing with diverse people generally. Graduates commented: *'Oral presentations boosted confidence and I was better able to interact with others'* and *'meeting and talking with people from different backgrounds was easy'*. The latter may be associated with the totality of the student experience, including extra-curricular activities, rather than being explicitly taught and emphasises the importance of students being able to identify and reflect on learning experiences and skills developed outside the formal curriculum.

**B4). Placements and practicals (34 out of 290 commenting)**

Some students singled out practicals, the final year project and placements as good features which prepared them well for their job. For example *'analytical chemistry pracs were excellent and good preparation for my job'*. This may initially appear to be in conflict with (A1) above which identified practicals as being poorly provided. However identification as a good feature was most often in the context of this being one of the few opportunities to develop the practical experience needed. Once again this emphasises the graduates' perception of the importance of good preparation for the practical aspects of all forms of employment.

It was clear that some students found 'real life' to be a bit of a shock: *'Early mornings' (0900hrs)*; *'working 9-5'* and *'work is tiring'* were mentioned as things for which graduates had not been prepared. One graduate commented *'The hardest part was customer contact, day after day, question after question'*.

While many will have experienced part-time jobs it appears that for some, the expected performance in a full-time job comes as a surprise.

The shortfalls in knowledge and skills perceived by graduates and detailed in sections A1 and A6 tie in well with those expressed by employers e.g. *'not really prepared for the real world – HE could do more on this'*, *'give them a real expectation of the world of work'*; *'lack of commercial awareness'*; *'Graduates need to have practical experience'* (Cushlow, 1999).

### **General discussion**

Even given the caveats with regard to possible distortions in the survey data, the general overview is that graduates feel they were well prepared with regard to the knowledge they required in employments as well as the IT and communication skills. The areas where courses are perceived as failing are in the provision of practical skills and experience and career management ability. The importance of final year projects and of placements in preparation for practical work cannot be overemphasised and students need a clear understanding of the implications of their choice not to take a placement or to do a library-based final year project.

The overall findings of a good knowledge base but poor practical skills and career information link with the current trend towards more integrated degrees. For example, in biomedical sciences, all Health Professions Council (HPC) accredited programmes must meet HPC standards of proficiency and thus logbooks for state registration have been replaced with registration portfolios. Here the knowledge-based proficiencies are met in the HE institute and the demonstration of skills is met in the main by work-based learning. This could, in theory, address some of the issues raised in this study, such as students unwittingly taking non-accredited programmes and the major issue of insufficient acquisition of adequate practical skills. This approach could, however, have the disadvantage of restricting the opportunities of bioscience graduates to enter the diverse range of professions currently available to them. In the light of broadening participation and increasing resource pressure in HE, one solution may involve adoption of an integrated and more vocational approach across all bioscience courses. It is also interesting to speculate as to where exactly does the problem lie? Is HE not providing what is required, are graduates not aware of what is actually on offer within the whole university or are they aware, but choose not to make use of what's available?

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