

# **Improving the PhD through provision of skills training for postgraduate researchers**

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# Improving the PhD through provision of skills training for postgraduate researchers

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## Abstract

Postgraduate research degrees in some systems, such as the UK, can be almost exclusively research based, with little formal, compulsory taught component. Government reviews recommend 10 days per year training in generic or transferable skills to ensure the suitability of doctoral graduates for employment. Professional bodies stipulate a commitment to continuing professional development as a requirement for chartered or accredited status. This includes The Chartered Society of Forensic Science and the British Association for Forensic Anthropology, as well as institutions for related fields such as The Institution of Engineering and Technology. Increasing numbers of universities therefore offer skills training programmes.

Research students were surveyed to investigate their attendance and views on non-mandatory training courses, and only 33% of students agreed that all training needs were covered by their degree. However, in contrast to the recommended training commitment, over a one-year period students attended a mean of  $5.5 \pm 0.7$  training days, with 12% attending no training. Responses indicate a significant demand for increased training in management, consistent with government reviews; however, this work also indicates that provision of technical training should be addressed.

Short course availability, design, delivery, promotion and recognition are discussed in relation to improving student uptake to reduce to the discrepancy between attendance levels and recommendations or aspirations.

# Improving the PhD through provision of skills training for postgraduate researchers

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## 1. Introduction

Research, and the subsequent peer-review and publication of robust scientific studies, is an important way to progress the forefront of knowledge in many fields. This is increasingly true in forensic science, where the UK Home Office Forensic Regulator has highlighted research and peer-reviewed publications as a cornerstone of ensuring both quality and confidence in forensic science (Rennison 2010). This need to improve and increase research which is of application to forensics is echoed by workers across industry and academic sectors (Jones 2011).

Research and development requires a high quality skill set, and entry into this world is frequently through completion of a Doctor of Philosophy (PhD or DPhil) degree, a programme of work usually completed over three years with advice and supervision of an established academic, leading to a substantial and original thesis on a specific topic. Doctoral level education programmes in some systems include a taught component, in addition to research, although in the United Kingdom, the standard route for a doctorate is almost always exclusively research based. However, many PhD graduates will go on to work outside the academic sector, within government or industry, in roles that are not necessarily research-focused (Barnacle and Dal'Alba 2011, Borrell-Damian *et al.* 2010, Neumann and Tan 2011); acquiring and recognising technical and transferable skills, such as management and critical review, can therefore be an important factor for doctoral students.

The desirability of expanding the training element within doctoral programmes is outlined in the Roberts Review (Roberts *et al.* 2002) which was commissioned by the UK Government to investigate the supply of people with science, technology, engineering and mathematics skills. The Review expresses concern on the suitability of PhD graduates for both academic and industrial employment, and recommends a strengthening of the training element, particularly in non-technical transferable skills. Elements highlighted include communication and teaching skills, management and commercial awareness (Roberts *et al.* 2002). This continued need to extend graduates' training and transferable skills base is

echoed in a recent report from Smith *et al.* (2010). Other works demonstrate the need for training in particular areas such as teaching (Hardre 2005) and show that the need to develop graduate attributes, both for academic and industrial work, crosses disciplines and international education systems (Foote 2010, Manathunga and Lant 2006, Muldoon 2009). Kehm (2007) investigates European development and global change to doctoral education, outlining the perception that the traditional PhD leaves graduates too narrowly focused, and lacking key professional skills. The Concordat to support the Career Development of Researchers, an agreement between universities and funders, states:

*“The importance of researchers’ personal and career development, and lifelong learning, is clearly recognised and promoted at all stages of their career.”*  
(Research Concordat 2010)

Training and development courses conducted during the period of a doctoral programme may assist students to gain skills that benefit their research during their degree, and assist with their future career. This also sets the foundations for an ongoing commitment to Continuing Professional Development (CPD), a recognised industry need (BBSRC 2010) and a key competency of many schemes awarding Chartered Status, such as engineering or biology (Engineering Council 2010, Society of Biology 2009) or the Accredited Forensic Practitioner scheme recently set up in the UK as the Chartered Society of Forensic Sciences moves from a learned society (The Forensic Science Society) to a professional body (CSFS 2014).

Many researchers highlight that the PhD course structure is continually evolving in order to cater for future career requirements (Gilbert *et al.* 2004, Pritchard *et al.* 2009, Borrell-Damian *et al.* 2010). Numerous studies (Borrell-Damian *et al.* 2010, Neumann and Tan 2011) show that approximately 50% of PhD graduates continue to a position outside the academic sector, Barnacle and Dal’Alba (2011) suggest that only a third of doctoral graduates will be employed in research work. This has contributed to developments in doctoral courses that include both an increase in transferable skills training components, and substantial contact with industry. This reflects a change from a PhD focusing on an outcome, a piece of research embodied in a thesis, to an increased focus on the process and training to be a researcher, or developing abilities to utilise acquired skills in a different setting. Professional development is of course not limited to training courses. Pritchard *et al.* (2009) examine training course programmes and show that in some cases these may not be the principal route to gaining transferable skills; Barnacle and Dal’Alba (2011) highlight that doctoral graduates regularly draw on research knowledge in their current employment, regardless of sector or industry.

The UK’s Engineering and Physical Sciences Research Council (EPSRC) planned an increase in user-led skills training within doctoral programmes (EPSRC 2009) and a number of recent initiatives have incorporated training courses into a doctoral level postgraduate qualification. These include cohort-based study at one of 115 EPSRC Centres for Doctoral Training across the UK (EPSRC 2014) which each concentrate on a particular engineering or physical sciences sector, such as Micro and Nano Materials and Technology at the University of Surrey, Formulation Engineering (Birmingham) or Photonic Integration for Advanced Data Storage (Queens University Belfast). The outputs from these centres may be applied to

forensic science, one centre addresses the subject directly, CDT in Security Science (University College London). A similar scheme across broader disciplines, The NewRoutePhD, was launched in 2001 by a consortium of UK universities, and is available across a range of subjects in different centres. The NewRoutePhD and the EPSRC Centres for Doctoral Training extend the traditional three-year, research-only doctorate to four years, and in addition to research, include advanced technical taught courses and professional transferable skills training (NR PhD 2014, EPSRC 2014). This is sometimes reflected in the use of a Master of Research or Postgraduate Diploma as an intermediate or additional award recognising both research and training in research methodology.

Cohort based doctoral training centres increasingly involve industry input, and this is also indicated by the provision of professional or practice-based doctorates, such as the Doctor of Public Health, DrPH, and the four-year Engineering Doctorate, EngD (EPSRC 2010b) which includes up to 25% training. Such schemes can focus on a primarily industrially based research component, improve links with industry and make graduates better prepared for non-academic employment. However, concerns have been raised on issues such as intellectual property, exploitation of developing ideas, communication and conflicts between professional development of students and the needs of employers (Borrell-Damian et al 2010, Jones 2010, Servage 2009).

With direct relevance to the model of postgraduate provision of forensic science within universities, this chapter investigates research students' assessment of skills gained by attendance on non-mandatory courses throughout postgraduate research degree programmes, and their attitudes concerning course usefulness, structure and integration.

## 2. Study of student perception of training needs

Postgraduate research students responded to a web-based questionnaire, advertised via university web pages, social networking sites and via direct emails through school and departmental contacts. A total of 49 respondents primarily from “research intensive” or “research led” UK universities completed the questionnaire, students’ research areas were split between life sciences (43%), physical sciences (29%) and humanities (29%). Respondents were also asked if they were part-time students (17%), had had more than three years industrial experience prior to their degree (45%) and if they were members of a professional organisation (60%) which could include organisations such as the Royal Society of Chemistry, Institution of Engineering and Technology or Chartered Society of Forensic Sciences.

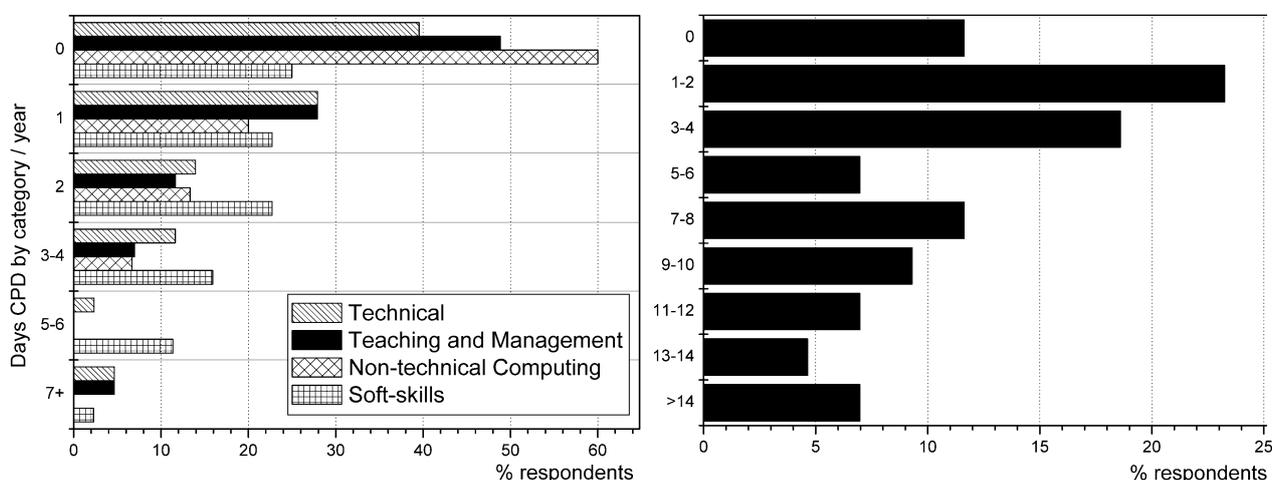
Respondents were asked to consider questions on attendance, relevance and format relating to courses in four categories:

- **Technical** (e.g. scientific instrument or technique training or technical software such as Matlab™ or Labview™)
- **Teaching and Management** (and people skills)
- **Non-technical Computing** (e.g. Microsoft Office™ or display equipment)
- **Soft skills** (e.g. Presentation skills, thesis writing)

It is worth noting that this classification caused some discussion from respondents on which elements could legitimately be classified as “professional development”. Some students and supervisors placed emphasis only on technical, subject related courses, rather than what they termed “vague transferable skills”. However, multiple workers (Roberts *et al.* 2002, Smith *et al.* 2010, Hinchcliffe and Jolly 2011) emphasise the need for development of attributes in these areas, and categories in this work on *Teaching and Management* and *Soft Skills* reflect these findings.

### 3. Training Course Attendance and Usefulness

The number of days of professional development training that students attended over the previous twelve months is shown in figure 1. This is in addition to any requirements for students' current degree course and is broken down into categories, as collected (figure 1a) and summed for total days attended by each student (figure 1b). 53% of students completed four days or fewer over the past year, and 12% conducted no CPD or training over any requirements of their degree programme.



**Figure 1.** Number of days training attended over the past year, by course category (a) and in total (b)

Mean attendance on courses was  $5.5 \pm 0.7$  days over the past year. Breakdown of attendance by course category and students' research topic begins to show some indicative trends. Technical course attendance shows significant variation with students' research subject, with physical science students attending a mean of  $2.7 \pm 0.9$  days, significantly more than humanities or life science students, who attend a mean of  $1.4 \pm 0.7$  or  $0.9 \pm 0.2$  days respectively. The overall levels of attendance are less than the ten days recommended by EPSRC (2010a) and Roberts et al. (2002).

Nevertheless, students recognise the importance of developing both research and transferable skills; in a survey of approximately 18,000 students conducted for the Higher Education Academy in 2009 (Kulej and Wells 2009), 89.2% agreed with the importance of developing research skills and 69.6% agreed that opportunities to develop transferable skills

were important. However, only 43% agreed they were encouraged to reflect on personal development during their degree. Students were asked to what extent they agree with the following statement, to assess their perceptions of the need for training over and above their current degree programme, and aspects of ease of facilitation of this.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<b>Qn1. All my training needs are covered by my degree course (%)</b>	<b>4.4</b>	<b>28.9</b>	<b>20.0</b>	<b>37.8</b>	<b>8.9</b>

From this it can be seen that only 33% students agree that all training needs are covered by their degree. This demonstrates the importance of training courses external to the degree structure of the current UK format, suggests that students recognise the need to source additional training from their university's graduate school or other providers.

Attending dedicated training courses is one route to acquiring a required or desired skill, and two thirds of respondents indicate they have supervisor support for this. Students who attended courses in the past year were requested to provide an assessment of the usefulness of this training for their current work. Respondents were also asked their opinion on whether attendance on these courses would be useful for their future employment, or in finding future employment. The resultant mean ratings from a scale of 1 (worthless) to 10 (essential) are shown in table 1.

	Usefulness for current research /10	Usefulness for future career /10
<b>Technical</b>	6.81±0.46	6.45±0.53
<b>Teaching and Management</b>	6.77±0.44	6.70±0.51
<b>Non-technical Computing</b>	6.36±0.53	6.50±0.53
<b>Soft skills</b>	6.03±0.42	6.44±0.42

**Table 1.** Mean ratings and standard error for usefulness of courses for current research and future employment

Over this sample set there are no significant differences in scores when results are broken down by course category or student research topic. However, from this data, it can be seen that students find courses useful for their current work, the mean rating for technical courses, for example is 6.8±0.5. Students also perceive training courses are useful for their future career progression, with similar ratings. Consideration therefore needs to be given to

additional factors which may affect student attendance on development courses, or facilitate improved uptake.

The results of this survey suggest that students are attending a low number of courses, relative to their aspirations and recommendations by supervisors and funders (Roberts 2002, EPSRC 2010a). Students were asked whether they agreed with further statements reflecting availability and ease of access of courses

	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
<b>Qn.2 My supervisor supports my attendance on external CPD courses (%)</b>	21.3	44.7	21.3	8.5	4.3
<b>Qn.3 There are CPD courses in all the areas I need (%)</b>	4.3	26.1	43.5	21.7	4.3
<b>Qn.4 I don't have time to attend all the courses I'd like (%)</b>	12.8	38.3	23.4	25.5	0

Only 30% of students questions can find courses in all areas they need, and only 26% of students indicate that they have time to attend all courses they wish. Additionally, two thirds of supervisors indicated that budgetary constraints affect the number of courses which students could attend. Research students were asked if they would like to attend more courses in the next twelve months, compared to their attendance in the previous year. Table 2, shows the responses to this question, which are subsequently discussed by category; although this preliminary study has a relatively small sample size, certain correlations can be made with greater than 95% confidence.

<b>Over the next twelve months, would you like to attend more CPD courses (in each category) than over the past year?</b>					
<b>% Respondents</b>	<b>Substantially Fewer</b>	<b>Slightly Fewer</b>	<b>About the same</b>	<b>Slightly More</b>	<b>Substantially More</b>
<b>Technical</b>	4.1	6.1	32.7	32.7	24.5
<b>Teaching and Management</b>	0.0	8.2	38.8	36.7	16.3
<b>Non-technical</b>	4.1	10.2	40.8	34.7	10.2
<b>Soft skills</b>	4.1	20.4	32.7	26.5	16.3

**Table 2.** Indication of future course attendance

Students showed a desire to attend more technical courses. 57% of respondents indicated they wish to attend more technical CPD, with 24% substantially more, and only 10% signifying they wished to attend fewer courses (t-test indicated a >99% confidence in positive difference from neutral). This desire for more technical training is correlated with: a perception of an absence of available courses (Pearson  $r=0.43$ ), the belief of usefulness of courses attended for future career ( $r=0.39$ ), and, more weakly, with a desire for courses to carry credits for qualifications or chartered status ( $r=0.29$ ). This is reflected in the Chartered Society of Forensic Sciences' requirement for professional development of 50 – 75 hours over three years to maintain professional membership (CSFS 2014). Other professional institutions offer alternative formalising structures for continuing professional development, such as the Society of Biology CPD scheme "Learning for Life" (Society of Biology 2009) or requirements for Chartered Engineer (Engineering Council 2010). However a previous attempt at providing a scheme for structured and evaluated professional development activity, encountered problems with participation. The Professional Formation and Development Scheme, run by the Institute of Physics and designed for recent graduates, including those in postgraduate education, was withdrawn due to a lack of participation in reporting of attainment and assessment of competencies (IoP 2002).

53% of respondents state that they wish to attend more Teaching and Managerial CPD courses. In contrast to the technical courses this is not significantly correlated with belief in usefulness for future career, or indeed current work. This notably and worryingly contrasts with the government reviews and other studies. The Roberts review (2002) and Smith *et al.*'s 2010 government report on postgraduate education both emphasise the need for development of students' people management skills. Kaplan (2011) highlights industry sources find that PhD graduates do not necessarily have appropriate business and communication skills. The desire to attend more courses in this category is correlated with the perception of a lack of available courses ( $r=0.42$ ) and a desire for courses to carry credits for qualifications, chartered status or other recognition ( $r=0.39$ ). For postgraduate students heading into academia, the recommendation that new academics hold an accredited teaching qualification is in addition to any subject-specific requirements, the review outlines that this training should be available to postgraduate students (Browne *et al.* 2010). The results of the current survey suggest an increase in the provision of courses in this category, or an increase in advertising or flexibility of provision, is required to meet these needs, and also a shift in mindset of postgraduate students who, in some cases, do not necessarily immediately see the relevance to their future work of what one respondent described as, 'vague transferable skills'.

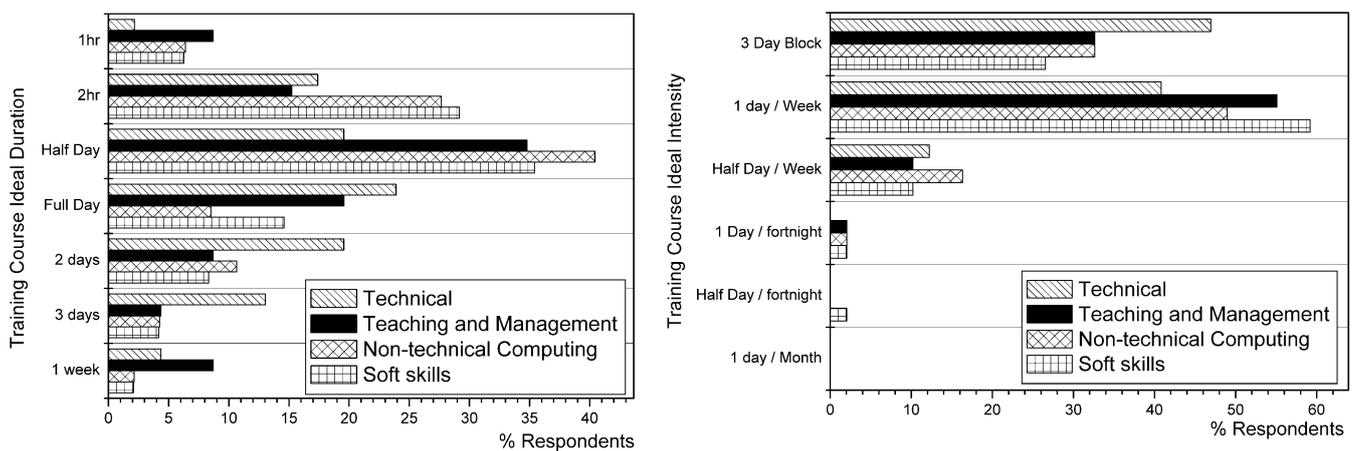
Non-technical computing course category has the lowest attendance rates, 45% of students wish to attend more courses. However, the profile of responses is not significantly different from a mean neutral response, indicating no significant net desire to attend more courses in the next twelve months. Students' plans for future attendance are correlated with a preference for accredited courses ( $r=0.30$ ) and for credit carrying courses ( $r=0.43$ ). This suggests that provision in this category is adequate. Incorporation of a training structure into a more formal scheme may be worth future study.

Desire for additional soft skills courses is negatively correlated with the number of days of soft skill training attended over the past year ( $r=-0.33$ ). This is also correlated with a desire for accredited courses ( $r=0.30$ ) and courses that contribute towards additional qualifications or other status ( $r=0.43$ ). This is the only category of courses where there is a significant negative correlation between days attended this year and desire to attend more in the next twelve months. This, and the absence of a correlation with course availability, suggests that there are satisfactory levels of provision in this area, or that students find that a short course is not suitable for growing this type of skill. This may be a reflection of progress since the Roberts Review in 2002, in an increased provision of courses in transferable skills which are geared for specific stages in the PhD (Gilbert *et al.* 2004, Brunel University 2010, Pritchard 2011). This provision well addresses some of the concerns of the Roberts Review (2002), though management and teaching courses are also identified by the Review as requiring improvement.

## 4. Training course delivery

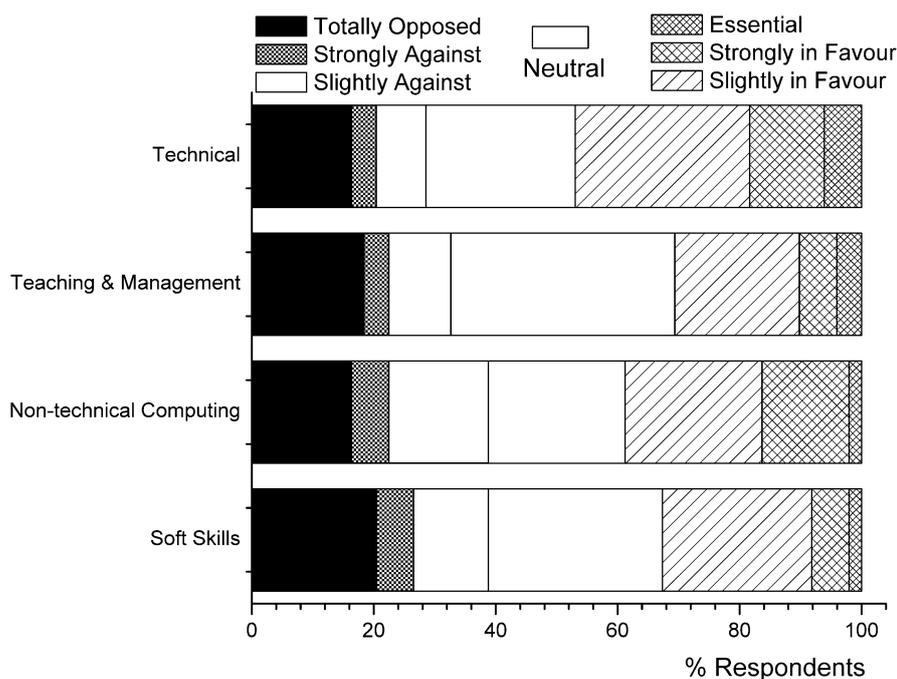
Research teams have reflected that although skills training programmes have become more widespread within PhD studies, questions remain on the more desirable and effective forms of such programmes (Gilbert *et al.* 2004, Pritchard *et al.* 2009). Addressing issues on delivery format, students were questioned on appropriate course duration, assessment of learning and external course recognition or accreditation.

Two questions assessed students' preferences on course duration. The responses are shown in figure 2 a and b. Students were first asked their views on the most appropriate course duration, with no further information on content. Modal response is a full day for technical courses, and half day in other categories (figure 2a). Secondly, a teaching time requirement of three days was specified, and students were asked to express a preference for block teaching, or for the course to be spread over a longer period (up to one day a month). Results are shown in figure 2b. For technical courses the mode response was a preference for a three day block course, for all other categories mode preference was for a course spread over three weeks with one day training per week. For all categories, less than 20% indicated a preference for courses running at a lower intensity. This block teaching approach has also been indicated as preferential for industry delegates (BBSRC 2010) and would improve flexibility of education provision benefiting both graduates and employers.



**Figure 2.** Students' preferences on course duration and intensity of training.

Figure 3 shows students' preferences on a compulsory assessed component of training courses. Although the principal mode was neutral, a substantial number of respondents were totally opposed to assessment. Students' comments on this question pointed out that attendance does not equate to understanding, a number were concerned with making the test compulsory, or the appropriateness of an assessment on each course. Other researchers have suggested the assessment of a threshold level of competence, particularly for practical work such as veterinary studies or teaching (Cockram *et al.* 2007, Browne *et al.*, 2010).



**Figure 3.** Students' preferences on compulsory assessment of training.

Students were asked if they preferred courses to be accredited or otherwise endorsed by an external organisation. A further question asked if there was a preference for courses to carry credits towards additional qualifications, chartered status or other recognition, table 3 details these results. There is significant proportion in favour for both questions. For example, for technical courses 78% favour accredited courses and 80% prefer courses carrying credits towards additional qualification or chartered status. Respondents highlighted a danger faced by offering recognised qualifications for skills training achievements, that the certificate becomes, "more valuable than the knowledge it is supposed to represent". Nevertheless, accreditation ensures a benchmark of quality, both to employers and delegates. Particularly for courses taken as general CPD rather than for immediate application, additional qualifications enable students to distinguish themselves from their peers by advertising their additional skills set, particularly important given criticisms of the traditional PhD structure (Kehm 2007, Roberts 2002). Such qualifications, with inherent portability, may also enable increased freedom of movement in the employment market, which would not necessarily be achieved with uncertificated training. Browne, for example, in the recent review of higher education in England (Browne *et al.*

2010) specifies not only teaching skills for academics, but accredited qualifications, as an indicator of teaching quality. An approach for postgraduate certificate or diploma courses (MSc level qualifications but one third or two thirds the content, respectively) has been trialled in particular industry sectors by a number of universities to address particular needs (Tallantyre *et al.* 2010, University of Nottingham 2011). Research councils such as BBSRC recognise the importance of training at the Masters level for skills development for industry (BBSRC 2010).

<b>Preference for courses to be accredited, endorsed or recognised by an external organisation.</b>			
% Respondents	<b>Against</b>	<b>Neutral</b>	<b>In Favour</b>
<b>Technical</b>	2.0	20.4	77.6
<b>Teaching and Management</b>	8.2	24.5	67.3
<b>Non-technical Computing</b>	6.1	32.7	61.2
<b>Soft skills</b>	8.2	28.6	63.3

<b>Preference for courses to carry credits as part of a scheme leading to additional qualifications, chartered status, or other recognition.</b>			
% Respondents	<b>Against</b>	<b>Neutral</b>	<b>In Favour</b>
<b>Technical</b>	4.1	16.3	79.6
<b>Teaching and Management</b>	10.2	14.3	75.5
<b>Non-technical Computing</b>	8.2	24.5	67.3
<b>Soft skills</b>	12.2	22.4	65.3

**Table 3:** Students' stated preferences for accreditation and recognition of training courses (values binned from degrees of preference)

However, it may be counterproductive to introduce further qualifications which may not achieve recognition from employers, and which may necessarily contrast with the responses in this survey suggesting compulsory assessment of courses may reduce attendance. Completion of an additional qualification concurrently with the PhD may also distract from or devalue the doctorate. A structured but flexible route, enabling attendance of CPD courses on a stand-alone basis, but with potential of accrual of credit towards a Masters level qualification may be a viable alternative and enable development of a skill set reflecting the needs of the student; a number of providers offer such qualifications through short courses (University of Oxford 2011; University of Surrey 2011). A different approach to provide recognition for training and development would be to promote the link between training and achieving personal accreditation such as chartered status or accredited forensic practitioner. Institutions offering routes to chartered status emphasise the link between commitment to continuing professional development and attainment of status (Engineering Council 2010, Society of Biology 2009). The Chartered Society of Forensic Sciences and Institute of Physics offer recognition of CPD courses from a range of academic or commercial providers, however, not all professional organisations offer endorsement of external courses as part of this scheme, indeed, the Institution of Engineering and Technology closed this programme at the end of 2009 (IET 2010). The use of such a route to

improve training uptake would require promotion of recognition of chartered or accredited status as a goal amongst postgraduate students, and emphasis on the link between commitment to CPD and professional status. As well as ensuring a wide ranging set of courses accrues CPD credits in such schemes, all requiring support from universities, training suppliers and professional institutions.

Training courses discussed so far are conducted in addition to the requirements of the students' degree programme. The survey suggests that postgraduate research students wish to have more formal training, and students were further asked if they wished to have more courses as part of their research degree.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<b>Qn5. I would like more courses to be incorporated into my degree (%)</b>	<b>21.7</b>	<b>39.1</b>	<b>23.9</b>	<b>15.2</b>	<b>0</b>

The survey indicates that 61% would like more courses incorporated within their degree. This is correlated with a perception of lack of available courses in relevant areas ( $r=0.42$ ) and the desire to attend more courses in technical ( $r=0.31$ ), teaching and management ( $r=0.36$ ) and non-technical computing ( $r=0.31$ ) categories, though there is no significant correlation with additional soft skills courses. Introducing a mandatory training requirement prior to completion of a PhD or transfer from probationary status is an alternative method for providing the needed skills training that has been highlighted by Government reviews and funding bodies (EPSRC 2010a, Research Concordat 2010, Roberts 2002, Smith *et al.* 2010). However, casting a note of warning, Barnacle and Dall'Alba ask,

“If we are seeking graduates with the ability to work creatively and contribute to innovation, are generic skills really what are required?” (2011, 467)

This query on appropriateness of training packages, together with the individual nature of research programmes and projects, as well as variation in student experience and background and subsequent employment route, mean that a rigid compulsory training structure could be counterproductive. Schemes that offer the provision of formal structured training as a component of research degree programmes, such as professional doctorates, EPSRC Centres for Doctoral Training or the NewRoutePhD scheme therefore require a certain element of flexibility and lead to further debate concerning the role of doctorates in education and skills training.

## 5. Conclusions

This chapter examines the attitudes of postgraduate research students across disciplines responded, assessing approaches to development courses in the following categories: technical, teaching and management, non-technical computing and soft-skills. Over a period of one year, the students surveyed attended a mean of  $5.5 \pm 0.7$  days non-mandatory training courses across all categories. This is less than the ten days recommended by funding bodies such as the Engineering and Physical Sciences Research Council (EPSRC 2010a), professional bodies such as the Chartered Society of Forensic Sciences (CSFS 2014) and Government review (Roberts *et al.* 2002). Students recognise the need to develop their skills by undertaking additional training over and above the PhD structure, as shown in this survey and other works (Kulej and Wells 2009, Pritchard *et al.* 2009). This is further reinforced by employers and reviewers (Roberts *et al.* 2002, Pritchard *et al.* 2009, Kaplan 2011, Hinchcliffe and Jolly 2011). Rationalising the relatively low attendance, only 30% of students indicate they can find courses in all the areas they need, and only 26% agree they have time to attend all the courses they need. A further survey of supervisors would enable examination of other factors such as budget constraints; however, 66% of students indicate that they have the support of their supervisors to attend external training.

A significant majority of students indicate that they wish to attend more technical and teaching or management courses. This is primarily correlated with the difficulties in finding courses in appropriate areas, and also with a preference for courses to carry credits towards additional qualifications, chartered status or other recognition. Credit carrying courses are significantly favoured; for technical courses 80% indicate this preference. Similarly, courses that are endorsed or accredited by an external organisation such as a professional institute are also favoured. This is reflected in a 2010 review of higher education in England (Browne *et al.* 2010) which suggests that to ensure quality standards in the sector, new academics require accredited qualifications in teaching, which should be made available to postgraduate students.

These factors may be addressed by increased provision of courses or improved coordination, including wider or more flexible access to existing course provision across the sector. In addition, increased efforts to promote chartered status and emphasis of the link between continued professional development and chartership, may also increase take-up of accredited training courses. Institutions offering routes to chartered status emphasise the link between commitment to continuing professional development and attainment of chartered status (Engineering Council 2010, Society of Biology 2009). However, not all offer endorsement of external courses as part of this scheme. Alternatively, to improve uptake and portability, recognition of training or developed attributes could be achieved through a system of credit bearing, masters level short courses utilised as CPD. This would enable development of skills as required and the accrual of credit over the course of the research degree and potentially during future employment. This would allow students to build

training at an accredited, recognised level and to work to the award of a postgraduate qualification over an extended period.

Perhaps suggesting more of a step-change in course provision, and reflecting the increase in Centres for Doctoral Training, 61% of students indicated that they wished for more courses to be incorporated into their research degree programme. This is correlated with the perception of a lack availability of relevant courses, and the desire for more training in categories other than soft skills. The incorporation of a flexible taught component into research degrees merits further investigation. This includes study into the provision of the existing research degree programmes that offer a training component, such as professional doctorates or the New Route PhD scheme, or alternatively incorporating training into a PhD programme as a requirement for transition from probationary status. However, PhDs are by nature both novel and individual, which could mean that a rigid compulsory training structure may be counterproductive. Gilbert *et al.* (2004) included comments from supervisors that show an antipathy to establishing a curriculum for PhD study, highlighting a danger that homogenising doctoral students in such a manner will remove the creativity and individualisation, which are essential to science. Barnacle and Dall'Alba (2011) show that doctoral graduates draw on their research work in future employment and question the use of generic skill training as an aid to creative and innovative working. Increased utilisation of centres that offer training in both generic and subject specific skills to the exclusion of other institutions may possibly reduce the effective provision of PhD training, as well as limit choice of supervisor. Flexibility in both provision and requirements for individuals is therefore key to developing researcher skill set within the PhD framework.

The Roberts review (2002) and a 2010 Government report into postgraduate education (Smith *et al.* 2010) have indicated the need for increased training in transferable skills to ensure PhD graduates meet the needs of both industrial and academic employers. The current study indicates a low level of course attendance and a demand for increased management training, which is consistent with these reviews. However, this work also indicates a demand for increased technical training. Principal student concerns are a perceived lack of available courses, time taken out of research for training and recognition of achievement. Some students also fail to recognise the need for training outside their immediate discipline. This suggests improvements are required to the provision, marketing and structure of training for postgraduate research students in order to adequately prepare them for work in academia, government or industry.

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