RSC response to UKRI consultation on the New Deal for postgraduate research

Section 1: Goals of postgraduate research training

Question 1: What should be the goals for contemporary postgraduate research training?

Postgraduate research training must adopt a model suitable for the modern economy and university system in order to retain its importance in developing the research and innovation workforce. There are a number of stakeholders who must have their needs met by the architecture and outcomes of the system, including: the student, the supervisor, the institution, future employers, and the research and innovation landscape as a whole. Ensuring an effective, modern model of postgraduate research training is important for underpinning the health of the chemistry research sector, both academic and commercial. Chemistry using professionals are highly skilled and make a significant contribution to the UK economy, generating an average of £83bn per year between 2013-19 in economic output and returning £3.2bn (2019) to HM treasury.[1]

Broad training relevant to varied career paths - Traditionally, postgraduate training was seen as the first step towards an academic career. However, there are far more job opportunities for PhD graduates outside academia than within it. Figures from the Engineering and Physical Sciences Research Council (EPSRC) show that 35% of EPSRC-funded doctoral graduates continue to a career in academia.[2] Doctoral students, therefore, need broader training that will be relevant if they move into a career in the wider knowledge economy, and that will support knowledge transfer and permeability between academia and industry. At the same time, completing a PhD requires undiluted time to effectively tackle the research project being embarked on. The PhD programme thus needs to achieve a careful balance of these aspects, ensuring that postgraduate education contributes to the development of individuals and to their professional skills and confidence, whether they stay in academia, take on a research-active role elsewhere, or follow another career path. We agree with the EPSRC's recommendation that all students "should have access to opportunities outside of their research project e.g. conferences, placements, outreach and public engagement." This additional experience is also of benefit to supervisors and those students who stay in academia, who gain additional exposure for their research and a wider network of contacts through external links. Further, it trains them to consider their research through a policy lens and understand its potential impacts, particularly to key challenges such as sustainable development goals. They will likely also have a better understanding of research commercialisation and innovation. These skills cannot be gained if students are in the laboratory for 100% of their time. Contact with industry and other external collaboration should be normalised as an integral part of most research projects.

Business, innovation and digital skills - More broadly, postgraduate research training is a way to develop individuals and the scientific workforce to support the government's intention for the UK to become a research and innovation powerhouse. The strength of university research and technology transfer supports the health of the innovative SME sector, particularly in deep tech sectors such as chemistry-intensive SMEs.[3] Our work has uncovered "a body of literature that finds a significant premium attached to the possession of a postgraduate degree and that argues that a PhD is required for significant innovation generated within industry."[4] Indeed, PhD holders are over-represented in this sector. Of respondents to our 2019 RSC Pay and Reward survey, 55% held a doctoral qualification.[5]

[1] Chemistry's Contribution: workforce trends and economic impact; Royal Society of Chemistry, Sept 2020, https://www.rsc.org/contentassets/8122a7694dd14a4f9779cec4e9dbb0a6/workforce-full-report
[2] Review of EPSRC-funded Doctoral Education, Oct 21, https://www.ukri.org/publications/review-of-epsrc-funded-doctoral-education/
[3] What works for innovation: supporting R&D and innovation in deep tech chemistry SMEs; Enterprise Research Centre, 2022, https://www.enterpriseresearch.ac.uk/publications/what-works-for-innovation-supporting-rd-and-innovation-in-deep-tech-chemistry-smes/
[4] Chemistry's Contribution, *as above*
[5] Ibid.

Postgraduate training should provide the skills for those students who will go on to work in these sectors, not just in research and development but also in the business and interpersonal skills necessary for innovation. Research into current chemistry intensive SMEs has revealed that a lack of business and leadership skills can be a barrier to company growth and productivity.[6] Other key skills postgraduates may wish to invest in developing include digital skills. All chemistry PhDs will have baseline computational, mathematical and statistical competence, but there is value for future job roles in developing experience in new digital tools for chemical sciences discovery and application.[7]

Interdisciplinary research skills - Many PhD programmes, particularly in Doctoral Training Centres, have recognised the value of interdisciplinary research skills, both for strengthening the doctoral research project and the students' transferrable skills post-PhD. Chemists have told us that an interdisciplinary research approach improves insight into the materials and technologies they develop, as well as instilling a collaborative mindset to research.[8] We would encourage the expansion of this skills base that all postgraduate students gain, to recognise that modern postgraduate training can lead to a wealth of varied paths and strong future research performance in both academia and industry.

Section 2: Areas of focus

Models and access

We are interested in bringing together evidence on:

- How different models can support postgraduate research students with diverse backgrounds and experiences, for example, whether some models better support people from different cultural, economic or educational backgrounds. We are also interested in whether the models themselves impact researchers' experiences and whether this might contribute to mental health outcomes
- Whether some models of postgraduate research better support the needs of organisations in different parts of the private, public or third sectors, or in different disciplines
- What changes are needed so that postgraduate research training is meeting the future needs of the economy, society and culture
- How postgraduate research students, employers, funders and universities and other research organisations are able to engage with one another such that they can be responsive and flexible to changing needs.

Question 2: Are there any additional areas that we should explore under models and access? Please state why.

Models of postgraduate research training should look at how to produce effective results while increasing flexibility and improving work-life balance.

The engagement and retention of postgraduate students is affected by the career potential they see after their studies. Issues affecting career progression are equally valid when considering postgraduate students. Chemistry often lacks work flexibility and demands long hours.[9] The effects of these pressures begin during postgraduate study.

Question 3: What challenges should we prioritise under models and access?

Challenges that should be prioritised under models and access include increasing diversity in science by retaining undergraduates from less-represented groups, and better facilitating interdisciplinary research.

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[6] What works for innovation, *as above*

[7] Digital Futures; Royal Society of Chemistry, 2020, https://www.rsc.org/globalassets/22-new-perspectives/discovery/digital-futures/rsc-digital-futures-report---digital.pdf

[8] Science Horizons; Royal Society of Chemistry, 2019, https://www.rsc.org/globalassets/04-campaigning-outreach/campaigning/science-horizons/science-horizons-report.pdf

[9] Breaking the Barriers - Women's retention and progression in the chemical sciences; Royal Society of Chemistry, 2018, https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/womens-progression/media-pack/v18_vo_inclusion-and-diversity-_womans-progression_report-web-.pdf

Retaining Black and minority ethnic chemists - The Royal Society of Chemistry has developed a significant evidence base on access to chemistry and how to increase diversity in the subject. This gives insight into all levels of a chemistry career, including postgraduate study. We are losing Black chemists after undergraduate level at an alarming rate, while people from other minority ethnic backgrounds also remain underrepresented at senior levels in chemistry. At undergraduate level, 4.9% of students identify as Black, higher than the 3.0% of the UK population who identify as Black. However, this drops sharply after undergraduate studies, to just 1.4% of postgraduate chemistry students.[10] Anecdotally, we understand that recruitment panels can lack diversity, which may then have an impact on acceptance or progress due to unconscious bias. Most initiatives to improve inclusion and diversity are voluntary and appear to be having a limited impact. Just 21 universities hold a bronze Race Equality Charter award, and none have received a silver or gold award, despite the scheme being launched in 2016. Tangible actions are needed in order to make this scheme further-reaching and impactful. Increasing diversity in chemistry, and science in general, is a key challenge for the UK to prioritise – including through UKRI's changes to postgraduate study. This should also be the duty of universities, publishers, employers and the whole science and research ecosystem. UKRI can lead with a clear position on what is expected of institutions as part of postgraduate recruitment and training.

Retaining female undergraduates - There are similar issues affecting the participation of women in science, including in chemistry. Again, the proportion of women falls with advances in career stage. Women make up 44% of chemistry undergraduates but only 39% of postgraduate students. Again, existing initiatives to improve conditions for women have been met with mixed results. Athena SWAN awards are held by many chemistry departments, but there have been criticisms of the initiative that it is "box ticking", that progress is limited, and that the administrative responsibility can often fall on female staff.[11] Improving the models of postgraduate research training must result in an improvement in diversity and inclusion within scientific research.

Students feeling a sense of belonging in their discipline – Tied to these diversity challenges, our research shows that a sense of belonging matters to all those working in the chemical sciences.[12] Feeling part of a shared community and being able to contribute to it improves the wellbeing and mental health of chemists. Although belonging and not-belonging can impact everyone, it can play a particularly important role in the lives and careers of those groups already underrepresented in the chemistry community. Given the acknowledged issues many postgraduate students suffer with their mental health,[13] ensuring that models of postgraduate research training encourage this sense of belonging from the start could go some way to improving wellbeing and resilience among postgraduates.

Facilitating interdisciplinary research and learning - Much of modern research is adopting an interdisciplinary focus. The research, communication and collaboration skills this entails, while becoming more valued, have not always been a default part of postgraduate projects. We would encourage new models of PhD programmes to include joint supervision of PhD students on interdisciplinary research projects. Most, if not all researchers, should have access to internships and secondments, or at least the chance to consult on projects within and between academia, SMEs, and large companies. Many PhD programmes require continued learning as well as research. Curricula for these aspects should be multi-disciplinary by default and developed across departments.[14] Effective interdisciplinary work requires development of the skills necessary for effective collaboration, but this is currently not always a strength of postgraduate research training. Our research in the chemistry community has found that collaborative work is an essential driver for the advancement of the chemical

[10] Missing Elements – Racial and Ethnic Inequalities in the Chemical Sciences; Royal Society of Chemistry, Mar 2022, https://www.rsc.org/globalassets/22-new-perspectives/talent/racial-and-ethnic-inequalities-in-the-chemical-sciences/missing-elements-report.pdf
[11] Breaking the Barriers, *as above*
[12] A sense of belonging in the chemical sciences, Royal Society of Chemistry, 2021, https://www.rsc.org/globalassets/22-new-perspectives/talent/belonging-in-the-chemical-sciences/rsc-belonging-in-chemical-sciences-report.pdf
[13] Depression and anxiety 'the norm' for UK PhD students, C. Woolston, *Nature* Career News, 2021, https://www.nature.com/articles/d41586-021-03761-3
[14] Digital Futures, *as above*

sciences, but that academic recognition and rewards culture has too strong an emphasis on individual achievement – overlooking effective collaboration.[15]

Routes in, through and out

We are interested in bringing together evidence on how:

- Postgraduate research training can actively support researchers with different experiences and career paths –bringing them into, and supporting them throughout, postgraduate research. This will include, but not be limited to, consideration of the impact of researchers' protected characteristics
- Postgraduate research students are supported so that they can go on to careers in sectors and organisations across the whole economy
- Postgraduate research students find or are given the necessary information to support them in their research and their development.

Question 4: Are there any additional areas that we should explore under routes in, through and out of postgraduate research? Please state why. [No additional areas]

Question 5: What challenges should we prioritise under routes in, through and out?

Ways of retaining talent, via career advice and visa application support, should be prioritised as part of this review.

Career advice - There is significant loss of talent from chemistry research at the postgraduate and postdoctoral levels. Support should be available for individuals making decisions at these career decision points through their departments, institutions and/or funding bodies.

Visa application support - The attractiveness of postgraduate research training in the UK is strongly related to work prospects after graduation. The three-year post-study visa available after PhD studies is a positive development. Institutions should provide support for these applications where relevant, including if the student is aiming to start a company rather than enter employment. This will help the research and innovation landscape outside of universities.

Rights and conditions

We are interested in bringing together evidence on how:

- Rights and conditions support postgraduate researchers with different needs
- Rights and conditions compare with other graduate opportunities, the reasons for any differences and their impact on relevant outcomes
- Postgraduate research students are enabled to continue with their research when their personal situation changes
- Postgraduate research students are informed about their rights and conditions; and that there is support in place if things go wrong.

Question 6: Are there any additional areas that we should consider in our work on rights and conditions? Please state why.

Rights and conditions for all postgraduate students should be broad and flexible enough to take account of any physical or mental health conditions that could affect their study, ensuring there are sufficient provisions and support to allow them to continue as effective researchers.

Flexibility for affected students – Postgraduate research in chemistry is often laboratory-based, which can introduce difficulties for individuals with disabilities or long-term health conditions, for example chronic energy-limiting conditions. Currently there is no high-level funding provision for postgraduate study on a part-time basis due to disability. Funding for sick leave from studies assumes a simple binary between 'sick' and 'healthy' which is inapplicable to those with chronic energy-limiting

[15] Science Horizons, *as above*

conditions, a demographic which promises to increase in number in the wake of the pandemic.[16] Similarly, long-term mental health conditions can require ongoing changes to work patterns that need flexibility of funding and working arrangements to accommodate.

Building inclusive cohorts – It is also critical that any postgraduate with a long-term physical or mental health condition is still able to feel an equal and active member of their research student cohort. Postgraduate training programmes need to ensure strong and flexible approaches to cohort building and have a peer support system in place to maintain this strength.

Question 7: What challenges should we prioritise in our work on rights and conditions?

Explore whether a PhD model closer to a graduate-entry job would provide more rights and protections

Rights and conditions of postgraduate students are frequently more casual than those of their peers in graduate employment. This can be a double-edged sword depending on the situation of the individual student and their relationship with their supervisor and/or institution. More rights and protections may be available to postgraduate students if the PhD model was made closer to a graduate-entry job. This may include limits on working hours, holiday allowance, and other standard aspects of employment contracts. This could go some way to addressing the long-hours culture prevalent in postgraduate research.

Funding and financial support

We are interested in bringing together evidence on:

- Whether the balance of funding between postgraduate research and other research and innovation investments is appropriate
- If funding and financial support for postgraduate research is sustainable and sufficiently resilient, and what financial challenges universities, grant holders and others face. The impact of these challenges on postgraduate research students
- If there is sufficient transparency about decision making in relation to postgraduate research funding and financial support.

Question 8: Are there any additional areas that we should explore in our work on funding and financial support?

Increasing the flexibility of funding provision may allow access to postgraduate study for those with issues that currently make it difficult such as illness or caring responsibilities. More flexible funding would also increase resilience to external disruptions, as covid-19 has demonstrated. Funding is a way to forge links with industry and flexibility should be introduced to make this possible for SMEs as well as large R&D intensive multinationals.

Provision of paid leave and flexible working arrangements - Challenges around funding models and support for individuals can be related to attrition from postgraduate study in some cases. This is similar to issues around funding for postdoctoral researchers, in that there is frequently no provision for paid leave, funding to continue research in the absence of the individual (e.g. due to illness or maternity), or funding that allows the flexibility for part-time working.[17] These issues will likely get worse if PhD stipends do not track inflation and cost of living increases, as increasing numbers of postgraduate students could face financial challenges that put their research and progression at risk.

Resilience to external disruption – The onset of the covid-19 pandemic was a shock to all, and chemistry was no exception. We surveyed the chemistry community, including postgraduates, in November 2020 to understand the impacts being experienced. When asked what would be an "increased challenge" in the coming year due to covid-19, main responses were access to a research laboratory (87%), developing new relationships with scientists and researchers (80%), work/life balance

[16] *House of Commons Science and Technology Committee: Diversity in STEM inquiry*, page 22, https://committees.parliament.uk/writtenevidence/42479/pdf/
[17] Breaking the Barriers, *as above*

(70%) and developing the skills needed for future employment (67%).[18] These answers represent difficulties in all the key focuses for postgraduate training that UKRI are investigating in this consultation – collaboration, employability, and work conditions. Rigid funding and deadline restrictions mean students may not be able to make up for lost time. Postgraduate training funding and conditions should include flexibility to allow students to achieve full benefit from their PhD experience regardless of external difficulties.

Expanding industrial links via CASE studentships - Research studentships in scientific disciplines, including chemistry, are more likely than other subjects to be financed by Industrial Cooperative Awards in Science & Technology (CASE studentships). Given the government's priorities to increase industrial research and innovation in the UK, future PhD models should look to expand these industrial links. It would be beneficial for innovative SMEs, as well as large established companies, to be frequently supporting CASE awards, as this will build links with universities and encourage PhD graduates with business and innovation skills developed during their study to work in the SME innovation landscape. The process can be quite resource-intensive so this would need to be a close partnership between the SME and the university.

Question 9: What challenges should we prioritise in our work on funding and financial support? [No view on priorities]

Overall approach

Question 10: Are there any areas that we could usefully focus on, or other questions that we should explore, not covered within our four focus areas?

Please state why and provide links to evidence where possible.

Postgraduate education should instil a broad mix of skills in students

The four focus areas proposed for the review are suitable to give oversight of the whole postgraduate research training landscape but are very broad. UKRI should ensure that key specific questions are given the attention required. As mentioned in our response to Question 1, it is crucial that we move away from the paradigm of postgraduate research as training for an academic career and look holistically at the destinations of all PhD graduates. Research training models must instil a broad mix of skills in students, particularly to equip them for research, innovation and business outside of the academic research landscape. This will pay dividends to the UK economy as we make headway on the government's goal to become a leader in innovation and research commercialisation. More details on the skills mix required to generate this outcome, particularly for deep tech chemistry companies, can be found in our Igniting Innovation report.[19]

Question 11: Do you have any further comments on the New Deal? [No further comments]

Section 3: Future engagement

For UKRI's work on the New Deal, we will:

- Articulate our purpose, decisions, or recommendations clearly
- Show how we have used evidence and taken it into account
- Support our communities to input where desired
- Make best use of resources
- Be open to challenge and change.

Question 12: What factors should we consider as we develop our engagement plans for future New Deal work? [No comments on engagement plans]

[18] Covid-19 impacts survey, Royal Society of Chemistry, 2021, https://www.rsc.org/globalassets/04-campaigning-outreach/policy/policy/covid-survey-findings---full-report.pdf

[19] Igniting Innovation, Royal Society of Chemistry, 2022, https://www.rsc.org/globalassets/22-new-perspectives/discovery/igniting-innovation/igniting-innovation-report.pdf